### Scientific American

### THE 10,000-TON SUCTION DREDGER "LEVIATHAN" FOR USE ON THE MERSEY.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN. Owing to the increasing draft and tonnage of steamers frequenting the port of Liverpool, the maintenance of an open channel in the estuary is one of vital urgency. Dredging upon a vast scale has to be maintained continuously to remove the sand, which threatens to silt up the navigable channel; and in order to carry out this work most efficiently the Mersey Docks and Harbor Board found it necessary to undertake the construction of a special type of dredger. The task of evolving such a craft was intrusted to their engineer-in-chief, Mr. Anthony G. Lyster, M. I. C. E., who is familiar with the peculiar conditions prevailing at this port, and who designed the sand pump dredger "Coronation," which, built in 1903, was at that time the largest and most powerful dredger of its type afloat. This latter vessel, 332 feet long by 53 feet beam and 20.4 feet deep, with a gross tonnage of 3,943 tons and capable of dredging to a depth of 65 feet with a pump capacity of 4,500 tons per hour, proved eminently successful, and he decided to design a new craft upon the same broad lines.

The new vessel, the "Leviathan," has now been placed in service, and ranks as the largest and most powerful dredger that has yet been placed in operation in any part of the world. It has an over-all length of 487 feet, a beam of 69 feet, and a depth of 30 feet 7 inches, these large dimensions being necessary to afford the requisite capacity and strength to carry the designed enormous load of 10,000 tons of sand. It is of the twin-screw, self-propelling, sandpump, hopper-dredger type, provided with twelve hopindicated horse-power of 2,800, coupled direct to four independent sets of centrifugal suction pumps connected to their respective suction tubes, two on each side of the vessel, with hydraulic sluice valves on the inboard side. Each tube has an internal diameter of 42 inches, is 90 feet long, and is bolted to a heavy cast-steel swivel bend at the upper end and a strong nozzle of special design at the lower extremity. These nozzles are provided with a cast-steel grid, so as to exclude material of such a size as would foul the pump. The swivel bends work in vertical slide frames riveted to the vessel's side, with trunnions to permit the suction pipes to hinge about its center, and thus permit raising or lowering to conform with the state of the tide during dredging.

The suction pipes have an inclination of 45 degrees when dredging to their lowest limit of 70 feet below sea level. Each tube is lifted and lowered by two strongly built derricks of steel, one at each end of the tube, and stopped on seats at the upper deck complete with blocks and flexible steel wire ropes led on to drums of its respective hoisting winch.

Fitted over each side frame are deck slides supported by strongly built seats on deck, to enable the suction pipes with swivel bend to be stowed inboard when not dredging. Each deck slide has a heavy cast-iron frame of the same section as the slide frame, and can be moved inboard or outboard by means of worm gear, the same being carefully adjusted so that it comes exactly in the same vertical plane as the slide frame when at its extreme outboard position, to permit the suction pipe to be lowered to its working position below the water level.

Emergency gear is fitted to each suction tube, so

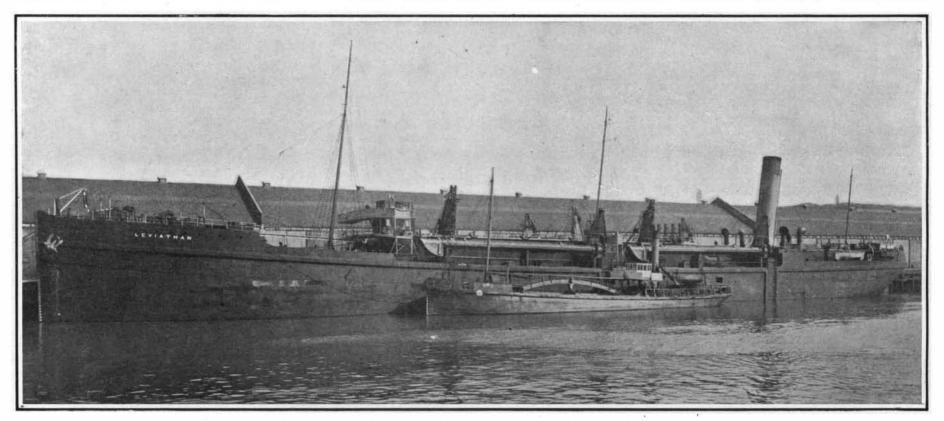
### SOME CURIOSITIES OF INVENTION.

From time to time we have collected in these columns instances of perverse mechanical ingenuity as well as misdirected efforts on the part of inventors, partly for the purpose of amusing the more soberminded, and partly as an instructive object lesson. On the opposite page will be found a number of such mechanical curiosities, some of them without any excuse whatever for their existence, others not without merit. We are indebted to the Illustrated London News for these examples.

The man who invented the padded chair and traveling carrier to prevent serious street-car accidents was evidently as much concerned with the comfort of the person to be saved, after collision, as with the mere act of saving. He has provided a fender which consists of a traveling belt and which serves the kindly purpose of conveying its human freight to a comfortable chair. It would seem from the illustration that the man to be saved is expected to be picked up in a sitting position facing forward so that he may be conveniently lodged in the padded seat. If he were picked up prostrate, he is presumably either dead or unable to sit, for not otherwise can we account for the chair.

The umbrella cap which emanates from the mind of another inventor certainly ought to serve its purpose of shielding the wearer from rain and sun if one may judge from the illustration. It is assuredly no uglier than the headgear in which civilized man now disports himself.

The method illustrated for arresting a runaway horse is certainly one of the wildest fancies which we have ever seen. The plan is nothing more or less than



THE 10,000-TON DREDGER "LEVIATHAN," WITH A 500-TON SAND PUMP DREDGER ALONGSIDE.

pers having a net total capacity of 180,000 cubic feet, and is fitted with pumps capable of dredging and filling itself with this load of clean Mersey sand in 50 minutes from a maximum depth of 70 feet, while the propelling machinery is sufficient to enable her to drive this load of 10,000 tons in her normal steaming trim, with coal bunkers and water tanks full, at the rate of 10 knots under ordinary working conditions. and to discharge this load very rapidly. The gross tonnage is about 8,000 tons, and the full load is carried on a mean draft of 23 feet. The fulfillment of these conditions insures the boat's possessing three times the power and capacity of any of the Harbor Board's existing dredgers, including the "Coronation," which is the next largest craft of this description in operation at Liverpool. The vessel, constructed by Messrs. Cammel, Laird & Co., the well-known British armament manufacturers and naval shipbuilders, at their Birkenhead works, is built of steel to class 100 A 1 at Lloyds. It has a complete steel upper deck sheathed with wood, and is divided transversely by thirteen watertight bulkheads extending from keel to deck. There is a longitudinal center line bulkhead dividing the hoppers, pump rooms, and boiler rooms, as well as No. 2 buoyancy spaces on either side of the vessel. These subdivisions, taken in conjunction with the watertight hopper side bulkheads, divide the vessel into about thirty separate watertight compartments. The steel structure has been arranged to give special strength to the vessel, in view of the great strains developed in loading and unloading the hoppers.

that in the event of an accident the suction tubes may be lifted by block and tackle led to the deck winches. Two of these winches are placed under the forecastle deck, and two on the poop deck. The four hoisting winches are inclosed in steel houses fitted with glass fronts, so that the winchman within has a clear and uninterrupted view of the derrick lifting and lowering gear. Each hoisting winch has four drums arranged in pairs, two for raising and lowering the suction pipes, and the other two for derricking in or outboard. These powerful winches are actuated by double-cylinder reversing steam engines.

The four dredging pumps are arranged to deliver the excavated material along pipes passing up through the deck into two landers, and at the point where they joint hydraulic sluice values are fitted. The landers are placed side by side with a center division, and run the full length of the hoppers. The lander valves worked by worm gear are placed over each hopper on the bottom of the landers, so that the discharge to any hopper can be controlled as desired. By these means the valves with control gear are also arranged in the steel division separating the two landers. The discharge of sand and water from any, or all, of the pumps can be controlled so as to trim the vessel as necessary. The hoppers placed forward of the pumping-engine room are built in twelve separate compartments, six on each side of the center line bulkhead. Each is fitted with Lyster's patent valves, having an opening 5 feet 6 inches in diameter through the bottom of the vessel. The hopper bottom plating has a steel slope in the four directions down to the edges of the valve seat bottom casting for quick discharge of the sand. (Continued on page 339.)

simply to lift the runaway horse bodily by using a derrick. Presumably the driver is to manipulate the derrick boom. Surely only a Titan could succeed in raising even the half-starved animal that is harnessed to the average tradesman's wagon.

The inventor of the horse velocipede pictured was concerned chiefly with the preservation of roads and horses' shoes. He places his horse upon a kind of treadmill which is operatively connected by crank mechanism with the road wheels. Presumably this wheeled horse is to be used as a kind of locomotive to draw the car.

The many disasters at sea have, no doubt, inspired the inventor of the combined waterproof coat and life raft which is illustrated. A central hollow structure is connected with a waterproof coat into which the passenger crawls and thus makes himself literally part of the life raft. Inasmuch as a hollow mast is provided to supply air to the interior of the life raft and water and inasmuch as provisions are there stored, the man in the rubber coat must have access to the interior. A counter-weight is provided to enable him to keep the raft in proper trim. The inventor of the cigar holder for hats, which is also to be numbered among these curiosities, seems to have been dismayed by the waste space in an ordinary "bowler" hat, for he has devised a means of utilizing the unoccupied space in a way which leaves one to infer that he never heard of pocket cigar cases. We believe that something like the sporting dress here shown has actually been used, but certainly not equipped with the hand-operated screw propellers. As shown in the detailed view, separate airtight chambers a a are employed, which are protected

The dredging plant, of the Gwynne type, comprises four sets of inverted vertical, triple-expansion, surface-condensing, direct-acting engines having a total

(Continued on page 340.)

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### THE 10.000-TON SUCTION DREDGER FOR USE ON THE MERSEY.

(Continued from page 332.) Each valve is of tapered cylindrical form extending the full depth of the hopper, with open-bottomed valve at the lower edge, and has a lift of four feet. These valves are worked by hydraulic cylinders controlled from fore-and-aft gangways and supported by a continuous fore-and-aft girder running the full length of, and above, the hoppers. Guide rings efficiently stayed to the hopper sides are fitted at the upper and lower parts of the valves for steadying the same.

A surface valve with lever for opening or closing it from the gangways is fitted on top of each hopper valve, to drain off the surface water. During dredging operations, the mixture of sand and water is delivered into the landers, and thence falls into the hoppers through the valves already described. The sand settles in the hoppers, while the surface water escapes aft along the waterway formed by the hopper coamings to the weir plates, which can be adjusted to suit the trim of the ship, and then flows overboard through large rectangular shoots, two of which are disposed on each side. When discharging spoil, the hopper valves are raised, and the sand rapidly falls through the openings in the bottom of the vessel.

There is an indicator fitted in the chart room which shows the draft of the ship, together with a complete system of repeating telegraphs and speaking tubes for transmitting orders to the pumping and propelling engine rooms, and to the different winchmen in their respective winch houses. Moreover, there are powerful electric alarm bells fitted to the pipemen's positions. Pushes are provided for each pipeman, and one on the navigating bridge, so as to give alarm in case of necessity.

The hydraulic installation carried out by the builders of the ship comprises a set of three-cylinder inverted high-pressure direct-acting engines having three cranks and three single-acting ram pumps, driven direct from the piston-rod crossheads. The hydraulic pressure is 800 pounds per square inch, and is used for working the four main sluice valves on the suction pipes at the sides of the vessel, as well as those on the.delivery pipes at the ends of the landers, and for opening and closing the twelve hopperdischarge valves.

The propelling machinery is right aft, and consists of two sets of inverted, vertical, triple-expansion engines of the same type as the pumping engines, each having cylinders of 221/2 inches, 37 inches, and 61 inches diameter, respectively, by a stroke of 45 inches. Steam is raised in four large single-ended marine boilers measuring 15,1/2 feet by 121/2 feet, placed between the propelling and pumping engine rooms and constructed for a working pressure of 180 pounds per square inch. Watertight doors controlled from the upper deck are fitted in the machinery space bulkheads to provide access from one room to another.

THE BUILDING OF A STORAGE BATTERY is described in Scientific American Supplement 1433. The side compartments adjacent to the hoppers, as well as the two forward The American Steel holes, are buoyancy spaces rendered A SEWING-MACHINE MOTOR OF SIMPLE DESIGN is described in Scientific American Supplement 1210. necessary for the vessel to support her A WHEATSTONE BRIDGE, Scientific Ameri-can Supplement 1595. Worker weight of hull, plant, and load on the specified draft of water. By E. R. MARKHAM Good articles on INDUCTION COILS are con-tained in Scientific American Supplements 1514, 1522, and 1527. Full details are given so that the coils can readily be made by anyone. The engineers and officers are housed Size 5¼ x8 inches. 367 pages. 163 illustra-tions. Price \$2.50 postpaid in the poop and the crew in the forecastions. Price \$2.50 postpaid In the poop and the crew in the forecas-hardening and tempering all grades of steel, by an acknowledged authority. The author has had twenty-five years' practical experi-ence in steel-working, during which time he has collected much of the material for this book. Care-ful instructions are given for every detail of every tool. Among the subjects treated are, the selection of steel to meet various requirements, how to tell The vessel is fitted throughout with a HOW TO MAKE A TELEPHONE is described in Scientific American Supplement 966. Purching machine, J. L. Bernard...... Pyrometer or heat measuring device, me-chanical, J. L. Zander..... Rail anticreeper, A. O. Buckius, Jr..... Rail clamp, J. C. Crowson... Rail joint, A. H. Neypher. Rail joint, H. Protheroe, et al..... A MODEL STEAM ENGINE is thoroughly de-scribed in Scientific American Supplement, 1527. 938,034 938,210 938,218 938,167 938,272 HOW TO MAKE A THERMOSTAT is ex-plained in Scientific American Supplements 1561, 1563, and 1566. The  $\mathbf{v}$ essel is fitted throughout with a Rail joint, H. Frotheroe, et al...... Rail joint and fastener, H. H. Markland.... Rail joint and tie bar and nut lock, C. C. & tool. Among the subjects treated are, the selection of steel to meet various requirements: how to tell steel when you see it; reasons for different steels; how to treat steel in the making of small tools. taps, reamers, drills, milling cutters; hardening and tem-pering dies; pack-hardening; case-hardening; an-nealing; heating apparatus; mixtures and baths, the best kind, and why; and in fact everything that a steel-worker would want to know is contained in this book. 938,262 ANEROID BAROMETERS, Scientific American Supplements 1500 and 1554. complete installation of electric light on 938,314 938,136 the incandescent system. The engines A WATER BATH, Scientific American Supple-ment 1464. and dynamo are placed in the propellingengine room. The engine is of the inclosed type, compound direct double-acting, and coupled direct to the dynamo, OUR SPECIAL OFFER: The price of these books is \$2.50 ach, but when the two volumes are ordered from us at one time, we send them prepaid to any address in the world on receipt of \$4.00. Each number of the Scientific American Supwhich is of the direct-current compoundplement costs 10 cents by mail. wound pattern. The powerful windlasses, Order from your newsdealer or from each driven by separate vertical engines MUNN & CO., Inc., 361 Broadway, New York MUNN & COMPANY, Inc. Publishers 361 Broadway, New York (Concluded on page 340.)

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ing the anchors.	

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### SOME CURIOSITIES OF INVENTION. (Concluded from page 332.)

by cork bulwarks b. We wonder if the inventor really believes in the efficacy of the hand-operated screw propeller which he has provided.

The Society for the Prevention of Cruelty to Animals would undoubtedly interest itself in restraining the inventor who devised the arrangement here shown to enable a dog or cat to run a sewing machine. We once heard of a man who patented a contrivance for driving a coffee mill by means of a bicycle, so that by the simple contrivance of riding a bicycle it was possible to obtain not only a certain amount of exhilarating exercise, but also to provide enough ground coffee for breakfast. This patentee surely outdoes him. The dog is made to rotate a central shaft carrying a large gear wheel which meshes with a small bevel gear carried on the sewing machine driving wheel. It seems to us that after the dog had sewed one shirt he would be too dizzy to do much more; or perhaps when that occurs, the central shaft is to be driven in the opposite direction.

A grain of common sense is to be found in the trunk that becomes its own luggage trolley, for it must be confessed that the ordinary trunk when full is not the easiest thing in the world to handle. The inventor has provided a single wheel and a folding lever handle which serves the purpose of pushing the wheeled trunk along. He evidently was not concerned much with the problem of the amount of space consumed by the wheels and the handle when folded within the trunk.

The handle shown for carrying parcels used in carriages has been employed in European railways. The device consists simply of two straps and a rest board, with the whole easily detachable. Straps serve the purpose of binding the rest board and walking sticks and umbrellas together.

A boat driven by windmills is certainly a mechanical curiosity. Just why this complicated arrangement of bevel gears connecting the propeller shaft with the vertical windmill shaft should be better than canvas transcends our imagination.

There is a touch of the Yankee in the fishing device, the last of the inventions illustrated. Evidently the inventor was accustomed to fishing in streams where bites were few and far between, and where patience was ill rewarded. He has contrived a fishing pole with a swinging arm carrying a clapper which is made to ring a bell as soon as a fish bites and swings the arm down.

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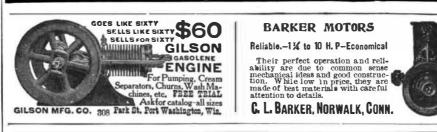
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Sewing machine guide for hat sweats, J. C.	937,784 938,436
Sewage discharge system, T. Ferguson Sewing machine guide for hat sweats, J. C. Ringe Shade and fixtures, window, Hughes & Rob- inson Shade and screen for windows, combination, Hughes & Robinson.	938 1.49
<ul> <li>Kinge</li> <li>Kinge</li> <li>Shade and fixtures, window, Hughes &amp; Robinson</li> <li>Shade and screen for windows, combination, Hughes &amp; Robinson</li> <li>Shade and screen for windows, combination, Shade bracket, L. E. McCahan</li> <li>Shade roller, W. D. Janes</li> <li>Shade roller, W. D. Janes</li> <li>Shade support. window, C. C. Brown</li> <li>Shaping machines, combined guard and chip breaker for. W. S. Richards</li> <li>Shears or the like, F. D. Davies</li> <li>Sheet feeder, A. J. Hodge</li> <li>Sheet metal into irregular forms, machine for cutting, A. W. B. S. Rohde.</li> <li>Sheet metal socket, E. L. Watrous</li> <li>Sheet metal socket, E. L. Watrous</li> <li>Sheet foader, J. B. Schman</li> <li>Shovel, adder, J. B. Schman</li> <li>Shovel, etc., handle, H. S. Urban</li> <li>Shifter, ash, H. L. Hastings</li> <li>Sifter, ash, O. Wolfenden</li> <li>Signal &amp; stem, W. Mears</li> <li>Signaling system, O. M. Leich</li> <li>Signaling system, O. M. Leich,</li> <li>Signaling system, electrical, F. M. Slough.</li> </ul>	938.147
Shade bracket. L. E. McCahan Shade roller, W. D. Janes	937,842 938,383
Shade support. window, C. C. Brown Shaper head, G. V. Fellows	938,207 938,135
Shaping machines, combined guard and chip breaker for. W. S. Richards	938.273
Shears or the like, F. D. Davies Sheet feeder, A. J. Hodge	938,04 <b>2</b> 937,80 <b>7</b>
Sheet metal into irregular forms, machine for cutting, A. W. B. S. Rohde	937,865
Sheet metal socket, E. L. Watrous Sheet of material, composite, L. S. & M.	938,403
Samuel	937,871 938,000
Shock loader, J. B. Schuman Shovel, etc., handle. H. S. Urban	938,438 937,894
Show rack, O. B. Winston. Sifter, ash, H. L. Hastings.	938,194 937,799
Signal recorder, electric, N. H. Suren,	938,103
Signal 87stem, W. Mears	937,837 937,837
Clampling System, O. M. Derch.	000,100
Signaling system, electrical, F. M. Slough.	938,345
Skate, combined roller and ice, J. A. Nolan. Skirt supporter. C. B. Patterson	938,345 938,168 937,852 937,943
Signaning system, electrical, r. M. Slough. Skate, combined roller and ice, J. A. Nolan. Skirt supporter. C. B. Patterson Sled, bob, N. Koopman Sled, folding or collapsible, W. H. Coleman. Small arms strikers or firing bolts, auto-	938,345 938,168 937,852 937,943 938,300
<ul> <li>Signing system, electrical, r. M. Slough</li> <li>Skate, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li> <li>Sled, bob, N. Koopman</li> <li>Sled, folding or collapsible, W. H. Coleman.</li> <li>Small arms strikers or firing bolts, automatic safety device for, J. Tambour</li> <li>Smelting, electric, E. R. Taylor</li> </ul>	938,345 938,168 937,852 937,943 938,300 938,349 938,352
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	938,168 937,852 937,943 938,300 938,349 938,352 938,351
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	938,168 937,852 937,943 938,300 938,349 938,352 938,351
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	938,168 937,852 937,943 938,300 938,349 938,352 938,351
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	938,168 937,852 937,943 938,300 938,349 938,352 938,351
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	938,168 937,852 937,943 937,943 938,300 938,349 938,352 938,351 938,443 938,143 937,908 938,143 938,143 938,108 938,108 938,108 938,108 938,278
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	938,168 937,852 937,943 937,943 938,300 938,349 938,352 938,351 938,443 938,143 937,908 938,143 938,143 938,108 938,108 938,108 938,108 938,278
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	938,168 937,852 937,943 937,943 938,300 938,349 938,352 938,351 938,443 938,143 937,908 938,143 938,143 938,108 938,108 938,108 938,108 938,278
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	938,168 937,852 937,943 937,943 938,300 938,349 938,352 938,351 938,443 938,143 937,908 938,143 938,143 938,108 938,108 938,108 938,108 938,278
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter, C. B. Patterson.</li> <li>Sled, bob, N. Koopman.</li> <li>Sled, folding or collapsible. W. H. Coleman.</li> <li>Small arms strikers or firing bolts, automatic safety device for, J. Tambour.</li> <li>Smelting, electric, E. R. Taylor.</li> <li>Smelting furnace, electric, E. R. Taylor.</li> <li>Smelting pipe and making same, corncob, T. J. Tyner</li> <li>Sounding tackle, Gutt &amp; Heyn.</li> <li>Spark plug, O. C. Winestock.</li> <li>Spark plug, F. H. Weinhauer.</li> <li>Spinning, doubling, and like tertile machine,</li> <li>Spinning ring base, M. H. Maloney.</li> <li>Spoke fastener. W. L. Jett.</li> <li>Sprayer, E. Harry.</li> <li>Sprayer, E. Harry.</li> <li>Sprayer, E. Harry.</li> <li>Stame, canceling, E. Z. Wilkoshesky.</li> <li>Stamp, time, J. J. Busenbenz.</li> </ul>	938,168 937,552 937,943 938,300 938,352 938,352 938,351 938,443 938,143 938,108 938,143 938,108 938,188 938,188 938,188 938,188 938,275 938,402 938,442 938,442 938,442 938,442 938,442 938,442 938,942 938,044 937,942 938,044 938,942
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter, C. B. Patterson.</li> <li>Sled, bob, N. Koopman.</li> <li>Sled, folding or collapsible. W. H. Coleman.</li> <li>Small arms strikers or firing bolts, automatic safety device for, J. Tambour.</li> <li>Smelting, electric, E. R. Taylor.</li> <li>Smelting furnace, electric, E. R. Taylor.</li> <li>Smelting pipe and making same, corncob, T. J. Tyner</li> <li>Sounding tackle, Gutt &amp; Heyn.</li> <li>Spark plug, O. C. Winestock.</li> <li>Spark plug, F. H. Weinhauer.</li> <li>Spinning, doubling, and like tertile machine,</li> <li>Spinning ring base, M. H. Maloney.</li> <li>Spoke fastener. W. L. Jett.</li> <li>Sprayer, E. Harry.</li> <li>Sprayer, E. Harry.</li> <li>Sprayer, E. Harry.</li> <li>Stame, canceling, E. Z. Wilkoshesky.</li> <li>Stamp, time, J. J. Busenbenz.</li> </ul>	938,168 937,552 937,943 938,300 938,352 938,352 938,351 938,443 938,143 938,108 938,143 938,108 938,188 938,188 938,188 938,188 938,275 938,402 938,442 938,442 938,442 938,442 938,442 938,442 938,942 938,044 937,942 938,044 938,942
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter, C. B. Patterson.</li> <li>Sled, bob, N. Koopman.</li> <li>Sled, folding or collapsible. W. H. Coleman.</li> <li>Small arms strikers or firing bolts, automatic safety device for, J. Tambour.</li> <li>Smelting, electric, E. R. Taylor.</li> <li>Smelting furnace, electric, E. R. Taylor.</li> <li>Smelting pipe and making same, corncob, T. J. Tyner</li> <li>Sounding tackle, Gutt &amp; Heyn.</li> <li>Spark plug, O. C. Winestock.</li> <li>Spark plug, F. H. Weinhauer.</li> <li>Spinning, doubling, and like tertile machine,</li> <li>Spinning ring base, M. H. Maloney.</li> <li>Spoke fastener. W. L. Jett.</li> <li>Sprayer, E. Harry.</li> <li>Sprayer, E. Harry.</li> <li>Sprayer, E. Harry.</li> <li>Stame, canceling, E. Z. Wilkoshesky.</li> <li>Stamp, time, J. J. Busenbenz.</li> </ul>	938,168 937,552 937,943 938,300 938,352 938,352 938,351 938,443 938,143 938,108 938,143 938,108 938,188 938,188 938,188 938,188 938,275 938,402 938,442 938,442 938,442 938,442 938,442 938,442 938,942 938,044 937,942 938,044 938,942
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	$\begin{array}{r} 938,168\\ 937,852\\ 937,852\\ 937,943\\ 938,300\\ 938,352\\ 938,351\\ 938,351\\ 938,351\\ 938,443\\ 937,908\\ 938,143\\ 938,108\\ 938,128\\ 938,138\\ 938,278\\ 938,327\\ 938,338\\ 938,429\\ 938,144\\ 938,038\\ 938,408\\ 938,408\\ 938,408\\ 938,414\\ 938,038\\ 938,408\\ 938,414\\ 938,038\\ 938,414\\ 938,038\\ 938,416\\ 938,357\\ 938,356\\ 938,316\\ 938,356\\ 938,3163\\ 937,855\\ 938,163\\ 937,855\\ 938,163\\ 938,316\\ 938,$
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	$\begin{array}{r} 938,168\\ 937,852\\ 937,852\\ 937,943\\ 938,300\\ 938,352\\ 938,351\\ 938,351\\ 938,351\\ 938,443\\ 937,908\\ 938,143\\ 938,108\\ 938,128\\ 938,138\\ 938,278\\ 938,327\\ 938,338\\ 938,429\\ 938,144\\ 938,038\\ 938,408\\ 938,408\\ 938,408\\ 938,414\\ 938,038\\ 938,408\\ 938,414\\ 938,038\\ 938,414\\ 938,038\\ 938,416\\ 938,357\\ 938,356\\ 938,316\\ 938,356\\ 938,3163\\ 937,855\\ 938,163\\ 937,855\\ 938,163\\ 938,316\\ 938,$
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	$\begin{array}{r} 938,168\\ 937,852\\ 937,852\\ 937,943\\ 938,300\\ 938,352\\ 938,351\\ 938,351\\ 938,351\\ 938,443\\ 937,908\\ 938,143\\ 938,108\\ 938,128\\ 938,138\\ 938,278\\ 938,327\\ 938,338\\ 938,429\\ 938,144\\ 938,038\\ 938,408\\ 938,408\\ 938,408\\ 938,414\\ 938,038\\ 938,408\\ 938,414\\ 938,038\\ 938,414\\ 938,038\\ 938,416\\ 938,357\\ 938,356\\ 938,316\\ 938,356\\ 938,3163\\ 937,855\\ 938,163\\ 937,855\\ 938,163\\ 938,316\\ 938,$
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson.</li> <li>Sied, folding or collapsible. W. H. Coleman.</li> <li>Small arms strikers or firing bolts, automatic safety device for, J. Tambour.</li> <li>Smelting, electric, E. R. Taylor.</li> <li>Smelting furnace, electric, E. R. Taylor.</li> <li>Smelting furnace, electric, E. R. Taylor.</li> <li>Smelting furnace, electric, E. R. Taylor.</li> <li>Small arms strikers or firing bolts.</li> <li>Sounding tackle, Gutt &amp; Heyn.</li> <li>Spark plug, O. C. Winestock.</li> <li>Spark plug, W. S. Bechtold.</li> <li>Spark plug, F. H. Weinhauer.</li> <li>Speedometer, E. Schneider.</li> <li>Spinning doubling, and like tertile machine.</li> <li>S. Z. de Ferranti.</li> <li>Spinning ring base, M. H. Maloney.</li> <li>Spoke fastener. W. L. Jett.</li> <li>Sparyer, E. Harry.</li> <li>Stamp, time, J. J. Busenbenz.</li> <li>Stamp, time, J. J. Busenbenz.</li> <li>Steam, time, J. J. Busenbenz.</li> <li>Steam equalizer, H. H. Wait.</li> <li>Steed, producing and refining. F. C. Perkins.</li> <li>Stereotype plate and base, separable, A. F.</li> <li>Herbieb</li> <li>Stitch separating machine, F. P. Taylor.</li> <li>Stitching apparatus, book, M. Christensen.</li> <li>Store, and water boller, combination gas, R.</li> </ul>	938,168 937,552 937,943 937,552 937,943 938,350 938,352 938,351 938,443 938,108 938,108 938,108 938,108 938,175 938,302 938,144 937,942 938,144 937,942 938,410 938,357 938,36
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson.</li> <li>Sied, folding or collapsible. W. H. Coleman.</li> <li>Small arms strikers or firing bolts, automatic safety device for, J. Tambour.</li> <li>Smelting, electric, E. R. Taylor.</li> <li>Smelting furnace, electric, E. R. Taylor.</li> <li>Smelting furnace, electric, E. R. Taylor.</li> <li>Smelting furnace, electric, E. R. Taylor.</li> <li>Small arms strikers or firing bolts.</li> <li>Sounding tackle, Gutt &amp; Heyn.</li> <li>Spark plug, O. C. Winestock.</li> <li>Spark plug, W. S. Bechtold.</li> <li>Spark plug, F. H. Weinhauer.</li> <li>Speedometer, E. Schneider.</li> <li>Spinning doubling, and like tertile machine.</li> <li>S. Z. de Ferranti.</li> <li>Spinning ring base, M. H. Maloney.</li> <li>Spoke fastener. W. L. Jett.</li> <li>Sparyer, E. Harry.</li> <li>Stamp, time, J. J. Busenbenz.</li> <li>Stamp, time, J. J. Busenbenz.</li> <li>Steam, time, J. J. Busenbenz.</li> <li>Steam equalizer, H. H. Wait.</li> <li>Steed, producing and refining. F. C. Perkins.</li> <li>Stereotype plate and base, separable, A. F.</li> <li>Herbieb</li> <li>Stitch separating machine, F. P. Taylor.</li> <li>Stitching apparatus, book, M. Christensen.</li> <li>Store, and water boller, combination gas, R.</li> </ul>	938,168 937,552 937,943 937,552 937,943 938,350 938,352 938,351 938,443 938,108 938,108 938,108 938,108 938,175 938,302 938,144 937,942 938,144 937,942 938,410 938,357 938,36
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson.</li> <li>Sied, folding or collapsible. W. H. Coleman.</li> <li>Small arms strikers or firing bolts, automatic safety device for, J. Tambour.</li> <li>Smelting, electric, E. R. Taylor.</li> <li>Smelting furnace, electric, E. R. Taylor.</li> <li>Smelting furnace, electric, E. R. Taylor.</li> <li>Smelting furnace, electric, E. R. Taylor.</li> <li>Small arms strikers or firing bolts.</li> <li>Sounding tackle, Gutt &amp; Heyn.</li> <li>Spark plug, O. C. Winestock.</li> <li>Spark plug, W. S. Bechtold.</li> <li>Spark plug, F. H. Weinhauer.</li> <li>Speedometer, E. Schneider.</li> <li>Spinning doubling, and like tertile machine.</li> <li>S. Z. de Ferranti.</li> <li>Spinning ring base, M. H. Maloney.</li> <li>Spoke fastener. W. L. Jett.</li> <li>Sparyer, E. Harry.</li> <li>Stamp, time, J. J. Busenbenz.</li> <li>Stamp, time, J. J. Busenbenz.</li> <li>Steam, time, J. J. Busenbenz.</li> <li>Steam equalizer, H. H. Wait.</li> <li>Steed, producing and refining. F. C. Perkins.</li> <li>Stereotype plate and base, separable, A. F.</li> <li>Herbieb</li> <li>Stitch separating machine, F. P. Taylor.</li> <li>Stitching apparatus, book, M. Christensen.</li> <li>Store, and water boller, combination gas, R.</li> </ul>	938,168 937,552 937,943 937,552 937,943 938,350 938,352 938,351 938,443 938,108 938,108 938,108 938,108 938,175 938,302 938,144 937,942 938,144 937,942 938,410 938,357 938,36
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson.</li> <li>Sied, folding or collapsible. W. H. Coleman.</li> <li>Small arms strikers or firing bolts, automatic safety device for, J. Tambour.</li> <li>Smelting, electric, E. R. Taylor.</li> <li>Smelting furnace, electric, E. R. Taylor.</li> <li>Smelting furnace, electric, E. R. Taylor.</li> <li>Smelting furnace, electric, E. R. Taylor.</li> <li>Small arms strikers or firing bolts.</li> <li>Sounding tackle, Gutt &amp; Heyn.</li> <li>Spark plug, O. C. Winestock.</li> <li>Spark plug, W. S. Bechtold.</li> <li>Spark plug, F. H. Weinhauer.</li> <li>Speedometer, E. Schneider.</li> <li>Spinning doubling, and like tertile machine.</li> <li>S. Z. de Ferranti.</li> <li>Spinning ring base, M. H. Maloney.</li> <li>Spoke fastener. W. L. Jett.</li> <li>Sparyer, E. Harry.</li> <li>Stamp, time, J. J. Busenbenz.</li> <li>Stamp, time, J. J. Busenbenz.</li> <li>Steam, time, J. J. Busenbenz.</li> <li>Steam equalizer, H. H. Wait.</li> <li>Steed, producing and refining. F. C. Perkins.</li> <li>Stereotype plate and base, separable, A. F.</li> <li>Herbieb</li> <li>Stitch separating machine, F. P. Taylor.</li> <li>Stitching apparatus, book, M. Christensen.</li> <li>Store, and water boller, combination gas, R.</li> </ul>	938,168 937,552 937,943 937,552 937,943 938,350 938,352 938,351 938,443 938,108 938,108 938,108 938,108 938,175 938,302 938,144 937,942 938,144 937,942 938,410 938,357 938,36
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	938,168 937,852 937,852 937,852 938,7843 938,300 938,352 938,355 938,355 938,355 938,143 938,108 938,108 938,108 938,108 938,108 938,108 938,108 938,144 938,084 938,144 938,084 938,144 938,084 938,144 938,084 938,144 938,084 938,145 938,1
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	938,168 937,852 937,852 937,852 938,7843 938,300 938,352 938,355 938,355 938,355 938,143 938,108 938,108 938,108 938,108 938,108 938,108 938,108 938,144 938,084 938,144 938,084 938,144 938,084 938,144 938,084 938,144 938,084 938,145 938,1
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	938,168 937,852 937,852 937,852 938,7843 938,300 938,352 938,355 938,355 938,355 938,143 938,108 938,108 938,108 938,108 938,108 938,108 938,108 938,144 938,084 938,144 938,084 938,144 938,084 938,144 938,084 938,144 938,084 938,145 938,1
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	938,168 937,852 937,852 937,852 938,7843 938,300 938,352 938,355 938,355 938,355 938,143 938,108 938,108 938,108 938,108 938,108 938,108 938,108 938,144 938,084 938,144 938,084 938,144 938,084 938,144 938,084 938,144 938,084 938,145 938,1
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	938,168 937,852 937,852 937,852 938,7843 938,300 938,352 938,355 938,355 938,355 938,143 938,108 938,108 938,108 938,108 938,108 938,108 938,108 938,144 938,084 938,144 938,084 938,144 938,084 938,144 938,084 938,144 938,084 938,145 938,1
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	938,168 937,852 937,852 937,852 938,7843 938,300 938,352 938,355 938,355 938,355 938,143 938,108 938,108 938,108 938,108 938,108 938,108 938,108 938,144 938,084 938,144 938,084 938,144 938,084 938,144 938,084 938,144 938,084 938,145 938,1
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter. C. B. Patterson</li></ul>	938,168 937,852 937,852 937,852 938,7843 938,300 938,352 938,355 938,355 938,355 938,143 938,108 938,108 938,108 938,108 938,108 938,108 938,108 938,144 938,084 938,144 938,084 938,144 938,084 938,144 938,084 938,144 938,084 938,145 938,1
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter, C. B. Patterson</li></ul>	938,1682 937,562 937,562 937,564 938,300 938,352 938,351 938,351 938,443 938,351 938,148 938,148 938,178 938,188 938,275 938,149 938,402 938,144 937,942 938,084 938,084 938,084 938,084 938,084 937,856 938,163 937,856 938,163 937,856 938,219 938,202 938,202 938,021 938,202 938,2
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter, C. B. Patterson</li></ul>	938,1682 937,562 937,562 937,564 938,300 938,352 938,351 938,351 938,443 938,351 938,148 938,148 938,178 938,188 938,275 938,149 938,402 938,144 937,942 938,084 938,084 938,084 938,084 938,084 937,856 938,163 937,856 938,163 937,856 938,219 938,202 938,202 938,021 938,202 938,2
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter, C. B. Patterson</li></ul>	938,1682 937,562 937,562 937,543 938,300 938,352 938,351 938,351 938,443 938,351 938,148 938,148 938,278 938,148 938,278 938,149 938,328 938,428 938,428 938,443 938,443 938,443 938,443 938,444 937,942 938,084 937,855 938,163 937,855 938,410 937,855 938,163 937,856 938,421 938,248 938,248 938,249 938,248 938,241 937,850 938,361 938,3
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter, C. B. Patterson</li></ul>	938,1682 937,562 937,562 937,562 938,542 938,551 938,443 938,351 938,443 938,351 938,443 938,148 938,178 938,178 938,144 937,942 938,144 937,942 938,144 937,942 938,144 937,942 938,144 937,855 938,163 937,855 938,163 937,855 938,248 938,249 938,249 938,249 938,249 938,249 938,249 938,241 938,261 938,261 938,271 938,361 93
<ul> <li>Skäte, combined roller and ice, J. A. Nolan.</li> <li>Skirt supporter, C. B. Patterson</li></ul>	938,1682 937,562 937,562 937,562 938,542 938,551 938,443 938,351 938,443 938,351 938,443 938,148 938,178 938,178 938,144 937,942 938,144 937,942 938,144 937,942 938,144 937,942 938,144 937,855 938,163 937,855 938,163 937,855 938,248 938,249 938,249 938,249 938,249 938,249 938,249 938,241 938,261 938,261 938,271 938,361 93



BIRDS OF PASSAGE.

(Continued from page 335.) of the return of the same individuals. Some wonderful European records of the return of a species to a given nesting site are given by the late Prof. Alfred Newton. A common falcon, Falco peregrinus, a cosmopolitan bird commonly known as the duck hawk, in this country, had its eyrie at one point in Finland for 110 years: that is to say, there was at this same point an occupied nest of this species from 1736 to 1855. At Oxbridge, in one or the other of two earthen bottles placed for their use, a pair of blue titmice had their nest every year, with two (Concluded on page 342.)

### By F. W. MANN, B.S., M.D. Size 71/2 x 93/4 inches. 384 Pages. Price \$4.00 postpaid

THIS is a thoroughly practical treatise and deals with a subject the literature of which is not commensurate with importance or interest, and it possesses unusual value, not only because it furnishes a large amount of information, or I importance or interest, and it possesses unusual value, not only because it jurnishes a large amount of information, of very practical kind, but because this information is the result of a practical experience on the part of the write extending over a period of thirty-eight years. The results of the author's experiments, as here given, have been prosent and theorizing have been so prevalent in rifle literature, the work has been kept free from speculation, except where they have been proved to be false or have been fully substantiated by recorded experiments. Most of the illustrations are phone when the part of the illustrations are phone. and theorizing have been so prevalent in rite literature, the work has been feel five from speculation, except where they have either been proved to be false or have been fully substantiated by recorded experiments. Most of the illustrations are phot graphic reproductions of the results of actual tests. Every page is full of interest for the rifle enthusiast. There is a fu discussion of various kinds of rifles, of the effect of difference of length, of variations of rifling, etc., as well as of instruction experiments such as that of venting the barrel near the muzzle. An idea of the contents may be gathered from a few of the subjects treated, such as the Personal Element vs. Mechanical Rifle Shooting; Utility of Vented Barrels; High-Pressu Sharpshooting Powder; Telescope Mounts; Ruined Rifle Bores vs. Smokeless Powder vs. Primers; Accurate Ammunition North and the provider is a primer of the term of the state of the interest of the result of the contents of the state Ammunition of the primer of the state of the contents of the state of the contents of the state of the contents of the term of the state of the contents of the state of the contents of the state of the contents of the term of the state of the contents of the term of the state of the term of the state of the term of the state of the term of t

Sharpshooting Powder; I electope Mounts; Kuined Rule Bores w. Smogress Powder w. Inners; Accurate Animalian Difficulties; Flight of Bullets; Gyration and Oscillation; Motions Executed by Normal Flying Bullets; Determining Rü Twists; Kinetics of Spin, etc. In many respects this work is unique in the literature that has been published on this subject It is a thoroughly practical work and will be found to be of very real value to those who are engaged in astudy of the ballish of the rifle with a view of improving the all-around efficiency of that weapon.

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