different parts of a coil, since such formulas have proved a very poor reliance when applied to an actual case. Slight differences in quality of material and sizes, or in thickness of insulation may lead one astray in the rigid application of a formula. Mr. Collins has taken up each part of an induction coil by itself and has discussed its size, construction, and adaptation to the other parts in a most complete and satisfactory manner. The best proportions are given for a series of coils giving a spark of twelve inches and under. Higher than this it is not necessary to go, since one requiring more energy than can be converted by a coil giving a spark twelve inches long will use a transformer and not an induction coil. The different uses of a coil are also considered and such variations as are necessary to adapt a coil to Roentgenray or wireless telegraph work are given. course these differences are principally in the secondary winding, where will be found in separate columns the data for these two services. This is a very important advantage of this book over other books recently published upon this subject. One cannot but notice the care with which small details are worked out. The tains 160 illustrations, while a single illustration may contain as many as 21 cuts as does the one on page 101, illustrating the construction of an interrupter. The data furnished in the form of tables are quite as full. Of tables there are 122, containing the sizes and dimensions of every detail of every part of an induction coil, and also the prices of every kind of material to enter into it. It is difficult to see how any one with the slightest skill in the use of tools can fail to build a good coil under the guidance this book affords. We believe it will displace all other books upon this subject.

THE MANUAL OF STATISTICS. Stock Ex-change Handbook. New York: The Manual of Statistics Company, 1909. 12mo.; 1194 pp. Price, \$5.

The thirty-first annual issue deals with railroad securities, industrial securities, government securities, stock exchange quotations. mining, grain, provisions, cotton, money, bank and trust companies. It is admirably printed and the maps are clear and numerous. The information conveyed is of exactly the nature which is of almost daily request in offices where financial matters are of any moment. It should be on the desk of every railway and bank official.

THE BANKING AND CURRENCY PROBLEM IN THE UNITED STATES. By Victor Mora-wetz. New York: North American Review Publishing Company. 12mo.

The author of this book, Mr. Victor Morawetz, is an authority on corporations and finance. His book is chiefly concerned with solving the problem of currency shortage, which seems to confront this country at recurring periods. He advances a plan for cooperation between the banks and the Treasury, which includes a note redemption fund to be elastic, regulating the uncovered volume of notes outstanding, and thus giving stability to financial institutions generally.

The New Building Estimator. A Practical Guide to Estimating the Cost of Labor and Material in Building Construction, from Excavation to Finish, with Various Practical Examples of Work presented in Detail, and with Labor Figured Chiefly in Hours and Quantities. A Handbook for Architects, Builders, Contractors, Appraisers, Engineers, Superintendents, and Draftsmen. By William Arthur, Box 482, Omaha, Neb. York: Published by David Williams Company.

Probably no task requires nicer judgment on the part of the engineer or architect than the estimation of building costs. For this reason any book which will materially help him in solving the peculiar problems which are presented to him must be welcomed. Arthur in his previous edition has demonstrated the fact that he is certainly competent to guide the estimating engineer and architect. The new edition of his book brings the prices up to date and incorporates much new tabulated matter.

INDEX OF INVENTIONS

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SOME NEW AMERICAN AEROPLANES.

(Concluded from page 421.) plane he has made use of eight of these propellers, and has arranged them in a line between the two planes, the idea being to give a propulsive effort throughout the entire width of the machine. It has also been proven that a number of small propellers will give a greater thrust per horse-power than one or two large ones. Mr. Kimball makes use of the same motor and wire-rope drive that he employed in his helicopter; but he has improved upon this drive by installing a friction clutch between the driving drum of the motor and the driven drum carrying the wire ropes. The clutch consists of a cast-iron floating ring, and also of a leather lining in these two drums. It allows a certain amount of slipping to occur at the start, so that the propellers are not strained and broken as before. It is also set so that it will slip with a 25 per cent overload. This im-\$54.00 per day provement, according to the inventor, of the CAMERA-SCOPE has made a rope drive for aeroplanes entirely practicable. The wire rope used is only 1/8 of an inch in diameter, and consists of six strands, each of which contains 19 wires. The rope has a tensile strength of 2,000 pounds, while the pull to which it is actually submitted is only 80 to 90 pounds. There are two endless cables, one for each set of four propellers. They are held under proper tension by a single idler for each one. The motor makes 1,900 revolutions per minute to 1,600 of the propeller, and the cable travels at the rate of 7,500 feet per minute, or about 86 miles an hour. The propellers have four blades each. They are 3 feet 10 inches in diameter, and have a pitch of 4 feet. The thrust obtained is about 175 pounds. The motor is a four-cylinder, two-cycle engine of an improved type, the cylinders being 4 x 4.

> The main planes of the Kimball machine are 37 feet by 61/2 feet, and they are spaced 4 feet 2 inches apart. They have a very slight curve of about 1 in 26, and their angle of incidence is about 5 deg. The rear edges project out 18 inches beyond the main plane and are rather flexible. The machine is provided with movable wing tips, 4 by 4 feet in size, on the ends of both planes. There is a double-surface horizontal rudder in front, 12 by 21/2 feet in size, the planes of which are spaced 3 feet apart. This rudder is located 934 feet in front of the main planes. It is operated by a lever convenient to the right hand of the aviator, while another lever worked by the left hand operates the two sets of four vertical rudders each, placed on the rear of the movable wing tips. This lever also operates the front wheel, in order to steer when running on the ground.

It develops 50 horse-power at 2,000 R.P.M.

The main features of the Kimball aeroplane are the use of multiple propellers and fitting of quadruple vertical rudders close to the main planes, near their extremities. If the inventor can run his propellers at a high enough speed to obtain from 300 to 400 pounds thrust, he will probably be able to get in the air; but at the present writing he has made only one attempt, which was unsuccess-

MAKING THE EYE OF SCIENCE, (Continued from page 425.)

of the proper shape and curvature.

But, you will want to know, how does the workman know when the glass to be tested fits the test glass? It is in this "how" that the exquisite fineness of the test resides, for the beautiful phenomena of Newton's rings comes into play here. Any extremely thin and attenuated film will show diffraction colors-soap bubbles are common examples. Every child knows that the bigger the bubble, the more beautiful the colors, and the grownup knows that the bigger the bubble, the thinner the film. When the glass to be tested is laid in the test-glass hollow, there is a thin film of air left between

(Continued on page 452.)

them. If this thin film of air is of even thickness throughout, the lens will be filled with a glow of color which changes as pressure may be brought to bear on the lens, thus thinning the film of air. If this glow is but one color and with no colorless patches, it is evident that the lens fits the glass perfectly; if the color is in bands or rings, or if more than one color shows, it is equally evident that the lens does not fit over all its surface, and consequently is not accurately ground and polished. This is the most delicate test known to science for equality of surfaces, and, if properly done, is absolutely reliable.

Microscopic objectives are tested in other ways. A 1/12-inch objective possesses a front element so small as to be seen with difficulty. It is actually 1/7 millimeter in diameter. This is too minute to admit of using the color test. These tiny lenses are ground by workmen of whom there are hardly ten in the world-men who have spent their lives over the tiny lathes and shells which grind hemispheres of glass of such exceeding smallness as this. It is more by feeling and intuition than by examination with magnifiers that they know when such lenses are true and perfect to their shells, but it is the fine optical and visual test on a diatom of fine markings and infinitely small size, such as Amphipleura pellucida or Pleurosigma angulatum, which determines their degree of perfection.

When all the elements of a fine anastigmatic photographic lens are ground, they have then to be cemented together, if it is a cemented lens, and, most important of operations, trimmed so that the optical center and the mechanical center of the several individual elements coincide. While the clear Canada balsam cement is yet "green," the glasses are revolved on a lathe, and the workman observes in them a reflection of a light sourcein the illustration, a burning gas-jet held in the hand. When the optical centers of the lenses do not correspond with the center of revolution or mechanical center, the reflected image dances. The cement is softened with heat and, by pushing on the edges of the revolving lenses, the operator makes them move against each other until the flame is reflected perfectly, and remains absolutely stationary while the lens revolves. When this condition is obtained the cement is allowed to harden, and the edges of the lenses are trimmed away with a diamond cutter.

The several lenses which compose a fine microscopic objective are not only centered and trimmed, but mounted, on one lathe and by one man, who also makes the mounting. This departure from the modern factory practice of "one man, one job," has been found necessary because no two lathes, be they ever so accurately made, revolve in exactly the same way, and if a lens be trimmed by one lathe and mounted in brass cells made on another lathe, the mechanical and optical centers will not align perfectly.

A 1/12-inch microscopic objective is a collection of lens elements, the magnifying power of which is equivalent to a single lens of 1/12-inch focus or about | Send for Boat Catalog No. 22 Today. It Shows 100 New Models 120 diameters. Its working distance, i. e., the distance the front element has to be from the object viewed, may be slightly greater or less than 1/12 inch. With an eyepiece of 1/2-inch focus, such a lens will give a magnification in the microscope of 2.400 diameters, or 5.760.-000 times. In other words, if a diatom could be enlarged in wax as much bigger than the original as the image of it is greater than it is itself, by such an equipment as is described above, it would hold on its surface 5,760,000 di-

It is obvious that any error in the making of such a lens is magnified equally with the object. If the lenses are in the least degree decentered, the amount of error is magnified according (Concluded on page 433).

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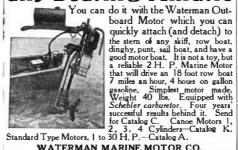
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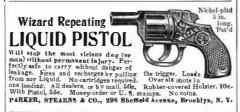
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Concrete, Reinforced Concrete Concrete Building Blocks

Scientific American Supplement 1543 contains an article on Concrete, by Brysson Cunningham. The article clearly describes the proper composition and mixture of concrete and gives results of elahorate tests.

Scientific American Supplement 1538 gives the proportion of gravel and sand to be used in concrete.

Scientific American Supplements 1567, 1568, 1569, 1570, and 1571 contain an elaborate discussion by Lieut. Henry J. Jones of the various systems of reinforcing concrete, concrete construction, and their applications. These articles constitute a splendid text book on the subject of reinforced concrete. Nothing better has been published.

Scientific American Supplement 997 contains an article by Spencer Newberry in which practical notes on the proper preparation of concrete are given.

Scientific American Supplements 1568 and 1569 present a helpful account of the making of concrete blocks by Spencer Newherry.

Scientific American Supplement 1534 gives a critical review of the engineering value of reinforced concrete.

Scientific American Supplements 1547 and 1548 give a resume in which the various systems of reinforced concrete construction are discussed and illustrated.

cientific American Supplement 1564 contains an article by Lewis A. Hicks, in which the merits and defects of reinforced concrete are analyzed.

cientific American Supplement 1551 contains the principles of reinforced concrete with some practical illustrations by Walter Loring Webh.

Scientific American Supplement 1573 contains an article by Louis H. Gibson on the prin-ciples of success in concrete block manufac-ture, illustrated.

cientific American Supplement 1574 discusses steel for reinforced concrete.

steel for reinforced concrete.

Scientific American Supplements 1575, 1576, and
1577 contain a paper by Philip L. Warmley.

Jr., on cement mortar and concrete, their
preparation and use for farm purposes. The
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Cycles and other vehicles, power transmission mechanism for motor, G. W. Sherman
Damper regulator, T. E. McKenna 923.054 922.910 922,663 922,537 923,047 923,047 922,968 922,476 922,584 922,949 922,751 922,935 923,050 922,575 Cutting off apparatus, Meeker & Carr. 922,495
Cyanids and cyanamids, production of, Bosch & Mittasch (Cycles and other vehicles, power transmission mechanism for motor, G. W. Sherman 922,634
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Decorticating fibrons plants, transportable apparatus for, E. A. Tubbs. 922,824
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922.734 to the magnification of the object seen It is essential, therefore, that the mounting be absolutely accurate, a condition satisfied by using the same lathe for both making the mount and trimming the lenses of the objective.

A photographic lens of high quality must pass tests of great difficulty and searching power. It is put in a camera and tried out on an accurate chart, and must "cover" a certain area of this chart at a certain distance, while rendering the image perfectly flat and without distortion. Uncorrected photographic lenses have a great many aberrations-curvature of the field, spherical aberration, coma, flare, astigmatism, curvilinear distortion, chromatic aberration; and a good photographic lens must be without these, or it fails to pass its tests. In the optical factory in which the illustrations for this article were made, every photographic lens is provided with a ticket, and on this chart the expert lens examiners put down a check mark against every fault or aberration of the lens under examination. A perfect lens such as is marketed, shows on its chait nothing more damaging than the presence of a few minute air bubbles, impossible to avoid in the special optical glass which is used in the production of "anastigmats." These air bubbles, often giving great concern to purchasers who do not understand their harmlessness, do nothing more damaging than to decrease the light-passing capacity of the lens by a percentage equal to the percentage their area is to the area of the lens-a small fraction of one per cent.

In addition to testing out for optical aberrations, the tester hunts for striæ, streaks in the glass, for strains, for improper centering, for imperfections of cementing, for poor mounting, for defects in the glass not classified, as scratches and marred places, so that, when a lens has finally passed the in spector, it is a perfect specimen so far as human ingenuity can make it.

Microscopic objectives, on the work of any one of which may depend not only the success of scientific experiments and the obtaining of new knowledge in a hundred branches, but even human lives, are the subject of the most minute care in testing. An unskilfed observer may find it difficult to distinguish between the image made by a poor and a good one-twelfth, but the scientist who uses it, and equally with him the trained man who examines it before its being put in stock, has no difficulty in finding ou from the severe test objects whether is will properly "resolve" the fine markings on a diatom, whether it has "color fringes" or not, whether its field is flat

Lens calculated, glass selected, shells and blocks carefully machined, glass ground once, twice, and again, lens elements tested, repolished or ground if necessary, centered, mounted, again tested, charted, and reinspected, the glass eyes of the microscope and the camera, twin cyes of science and the two most important tools in the laboratory go from the factory all over the world to the laboratories where are made a large per cent of all the discoveries in science of all kinds, but particularly in the natural sciences and in all those de partments of human knowledge which have to do with the body and with health and the cure of disease. And all the work done in these laboratories depends in the first instance on a little bit o glass, a mathematical formula, and the precision with which the glass can be made to fit the $x^2 n^2$ of the master opti

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Old objects of bronze and copper are usually covered with thick layers of oxidwhich make it impossible to recognize the true character of the metal or alloy The removal of this highly valued pating is not generally allowable, and the metal

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5	Gas machines, interlocking device for, L. H. Miller Gas, manufacturing, W. H. Cone. Gasolene engine, H. J. Wegner. Gate, Z. T. Cox. Gate opener, F. A. Schuster. Gearing, G. Westinghouse. Gearing, reversible transmission, M. W. Kouns	922,827
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e y.	Oil switch. H. L. Van Valkenburg	922,996 922,825 922,577
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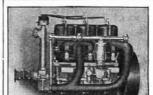
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alverizing roller, E. E. Porter 922.505.	922,506	
amp, hydraulic air, P. Lewis	923,053	
ump or condenser, air, H. Keller	922,595	1
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points and edges is too small to afford the desired indications. Two German investigators, having found that pure copper and bronzes containing various proportions of tin give characteristic streaks when rubbed on a touchstone, have devised a method of determining approximately the composition of any bronze object by comparing its streak with those made by a series of bronze bars of known composition. In practice, four such bars are found sufficient. The four bars are rubbed on the touchstone (Lydian slate or polished biscuit ware) and by the side of the four marks a fifth is made with a point or edge of the object under investigation. Pure copper gives a pure red streak, but a tinge of yellow is added by as little as 1 per cent of tin.

Chemical analyses of prehistoric bronze show percentages of tin ranging from 1.5 to 30, but very few specimens contain less than 6 or more than 12 per cent of tin. Silver, lead, antimony, arsenic, bismuth, nickel, and cobalt occur only in traces, and the proportion of iron is also very small in most cases. It is a remarkable fact that nearly all prehistoric bronzes are very nearly or quite free from zinc, of which many modern bronzes contain as much as 10 per cent.—Umschau.

America's Heavy Fire Loss.

At the forty-third annual meeting of the National Board of Fire Underwriters, held in New York city May 13th, President J. Montgomery Hare made an address, in which he stated that a comparison with statistics of losses in foreign countries shows that the loss per capita in the United States is from 10 to 30 times greater than in the principal European cities. For the last five years, he said, the annual fire loss in this country has averaged \$269,200,412, the total for the period being \$1,346,022,059, or about threequarters of a million for each day of the five years. In this period the figures were largely increased by the San Francisco conflagration, but even taking the two years since then the losses have kept well above the \$200,000,000 mark.

Without counting losses from forest fires, the destruction of property in 1907 by fire totaled \$250,084,709, and in 1908, \$217,885,850. The figures for this year give no promise of improvement, President Hare said, having reached a total of nearly \$53,000,000 for the first three months.

According to dispatches from Atlanta, nothing which has been suggested for the benefit of the South since the war has aroused such unanimous enthusiasm as the proposed highway from New York to Atlanta. Whereas the suggestion originated with automobile users, it is obvious that any scheme for the promotion of good roads through country districts remote from railroads must directly benefit agricultural and other large communities largely dependent upon highways for transportation. Three alternative routes have been suggested, all of which follow the same course from New York to Philadelphia. Two routes thence to Washington are identical, whence one lies through Rapidan, Charlottesville, Lynchburg, Danville, Greensboro, and Salisbury, where it joins the third route and reaches Atlanta via Charlotte, Blackburg, Spartansburg, Winder; while Hartwell, and goes through Richmond, Petersburg, Raleigh, Columbia, S. C., and Royton to Winder. The third route leaves Philadelphia westward to Harrisburg, thence down the Cumberland and Shenandoah valleys to Harper's Ferry and Lexington, crossing the mountains to Martinsburg and Salisbury and continuing as above. The New York Herald and Atlanta Journal have offered prizes for the best sections of road in the various districts, and an endurance test for automobiles is projected, with the object of comparing the results on different routes, the ultimate decision as to the highway route being dependent upon the local road conditions achieved by local authorities.

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1	Slip coupling, E. J. Gulick	923,043
1	Smoke consuming furnace, P. J. Flanagan	922.871 I
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	Stream motor, P. J. Hansen	922,890
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١	Tag or check, A. S. Rheaume Talking machine stand and horn, combined, H. C. Miller, reissue Tank heater and feed cooker, J. S. Christen-	12,963
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1	Tive protector, E. J. Weidner	922,739
ι		923,059
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l	Toy, L. W. King Toy spinner, W. Bohn	922,775 $922,842$
,	Toy vehicle, H. T. Kingsbury	923,039 923,104 922,602 922,775 922,842 922,914 922,639
5	Toy spinner, W. Bohn Toy vehicle, H. T. Kingsbury Toy, wheeled, J. B. Spencer Trace fastener, B. F. Woodhouse Train or vehicle, electric, J. L. Creveling.	
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	Brock	922,662
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'	Callan	922,562 922,643
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1	Type ribbon handling device, E. C. Mag-	
	Typewriting and calculating machine, com-	922,927
	Typewriting machine, G. C. Carhart	922,559 923,016
	Typewriting machine, O. Woodward	923,016 923,099 923,106
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•	923.120, Typewriting machines, decimal spacing mechanism for, Laganke & Smith	
-	mechanism for, Laganke & Smith Type writing machines, variable carriage feed	
l	for, J. A. Smith	922,534
,	Valve, C. F. Fernald	922,925 922,686
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	Eadie Vehicle wheel. E. S. Kintz Vehicles, device for automatically stop-	922,597
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