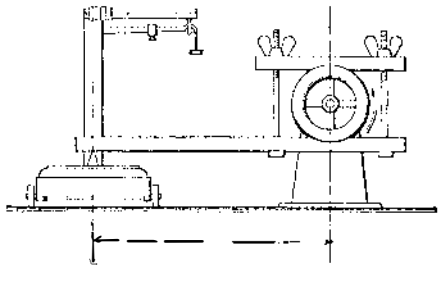
swer is simply his opinions, and another has as good a right to differ as to agree. We think it is generally held that force is not inherent in matter, since the same amount of matter can have different quantities of force at different times. For example, water in the forms of ice and steam possesses very different amounts of force from what it has as water. At absolute zero matter has no heat energy. It is probable that some hold the material view of life, that it is similar to ordinary forces, but that is not our personal view. We think too that the brain is the organ of a being who reasons, acts, and controls his own actions, for which he is held responsible both in law and morals. This view seems to us to be fundamental to the existence of the state and nation as well as to morality. So too we should say that quality of brain is more controlling than quantity, although very small brains are usually indicative of low intelligence. No balance can determine the qualities of a brain completely, any more than a scalpel can separate, or dissect life from the living being, and say, "I have found it." We believe that animals can be hypnotized.

(9769) J. W., writes: I always like to read the SCIENTIFIC AMERICAN, but I must take exception to the article, "The Pigmies of the Congo," of August 5. I cannot see how *you* can use such apodeictic statements regarding the long-exploded *theories* of evolution. I think that is not worthy of the SCIENTIFIC AMERICAN. Again, we have had now *ad nauseam* about reasoning cats. Animals (brutes) cannot reason, simply because they have no *rational soul*. The brain can *think* no more of itself than an ax can chop of itself—both are but instruments in the hands of an individual that *knows how*. A. We note with regret your criticisms of certain expressions in a recent article regarding pigmies, and also of the letters from correspondents showing remarkable instances of intelligence in animals. The printing of a letter from a correspondent does not in any way commit the paper to an indorsement of the views contained in the letter. The correspondence column is the property of the correspondents, and very frequently matter appears there to which the editor would personally most emphatically dissent. It seems to be the inalienable right of Americans to an expression of their opinions in print, and we are quite willing to grant some space to such free expression. We feel sure that good comes of it. However, with reference to the remarkable instances cited, we simply ask why deny to a quadruped a mode of action which is granted to a human being under similar circumstances. If a young child jumps up and opens a door in the manner the cat did, without any instruction, we should call it remarkable and an act of reason. The difference is not far to seek. The cat goes no further; the child does. Animal reason is narrow in range, and cannot be indefinitely developed. Nor can the child's, for that matter. But the human limitations are far beyond those of the animal. We believe that our view is shared by many scholars. As to the hypothesis of evolution, while we do not elect ourselves defenders of it or of any other special mode of the production of the present state of life on the earth, we must say that our acquaintance with the colleges and the professors of biology in them leads us to think that evolution is now more firmly believed by those whose studies give them the right to an opinion about it than it ever has been. We do not know a professor of biology who is not an evolutionist. Doubtless the pendulum of thought in this direction is not yet at rest, and will swing to and fro so long as mind remains active, but it seems certain that the old beliefs have no longer the hold upon scholars that they had previous to the publication of the "Origin of Species" by Mr. Darwin. We are not biologists, but as careful observers of the trend of science we think we rightly represent the state of present opinion.

(9770) J. B. A. says: In "Notes and Queries" No. 9544 asks for rule for calculating power of gas engines, and the answer gives the rule which answers a question that I would have asked sooner or later, but I wish to go a little farther and ask: How do you proceed in making the "actual brake test" for horse-power in gas engines? I bought an engine rated at 2½ horse-power, and they wrote me, after shipping, that the engine developed nearly 4 horse-power actual brake test. A. In order to make a brake test of an engine, it is necessary to construct on the flywheel of the engine a Prony brake, which acts on the principle of the one shown in the drawing. Two



pieces of wood are clamped about the pulley in such a way that the friction can be increased or decreased, as desired, by tightening the bolts. If the pulley is large, very often a number of ropes are used in place of the lower clamp in such a way that they may be tightened by means of screwing up a bolt from the pulley. One of the arms is extended a considerable distance, so as to allow its farther end to rest on a knife edge on the platform of a scale, or else be attached to a spring balance. In order to make tests, the screws of the brake are tightened until the engine is carrying the full load that it is able to carry without having its speed reduced too much. The pressure which the arm exerts on the platform scale is weighed, and the number of revolutions which the engine makes per minute is counted. During the test it is often necessary to have some means of applying water to the pulley to prevent its becoming too hot. The horse-power is figured by the following formula: Horse-power = 6.28 times the weight on the scale in pounds times the length of the arm measured from the center of the pulley to the knife edge in feet, times the number of revolutions per minute, divided by 33,000.

(9771) F. W. C. asks for a liquid polish for metals. A. Try the following:

Peroxide of iron (jewelers' rouge)	20 parts
Rotten stone	20 parts
Infusorial earth	20 parts
Oxalic acid	1 part

Palm oil sufficient.
Vaseline sufficient.
Oil of mirbane sufficient to perfume.

Pulverize and mix, so proportioning the palm oil and vaseline that you have a liquid sufficiently "thick" to hold the powders in suspension. We would remind you that the preparation of polishes, simple as it seems, is an art, and, like every other, requires a certain amount of practical experience, as well as a knowledge of the materials entering into the composition of the polishing mixture used, and of their preparation for use. To attain a high and uniform grade of polish, the materials must be reduced to a very fine and uniform powder. One single grain of the material larger or sharper than the rest will produce scratches that interfere with the finish given the metal. To make sure of your jewelers' rouge being free from dust and grit, prepare it fresh, as follows: Make a solution of iron sulphate (copperas), and another of oxalic acid. Add the latter to the former, as long as it throws down a precipitate. Filter off the liquid, and wash the residue on the filter with repeated charges of water, and dry. When dry, place in a suitable container, and heat gently. It soon ignites and burns until only an impalpable powder is left. This is the polishing material. The infusorial earth must be freed from sand, grit, etc., and reduced by grinding to a condition similar to that of the iron peroxide. The rotten stone and acid must also be powdered. If care and attention be given to these details, you can scarcely fail to get good results.

(9772) L. L. L. asks: Why do all dummy advertising clocks in front of jewelry stores read 8 o'clock and 17 minutes? A. The time on the dummy watches used by jewelers is the exact time when Abraham Lincoln was assassinated.

(9773) F. B. W. asks: Can you explain the phenomenon of the Aurora Borealis? A. We cannot explain the theory of the Aurora Borealis. The most we can do is to state the view held by the best scholars concerning it. To begin with, highly heated metals or carbon send out numerous minute particles with high velocities. These particles are called corpuscles, or electrons. They are known to carry charges of negative electricity, and to move with a very high velocity. It is reasonable to regard the sun and other stars at their enormous temperatures as sources of such particles, which move in mighty streams through the celestial spaces. When such particles strike a rarefied gas they render it luminous, as is seen in vacuum tubes. Such luminosity is associated with the discharge from the negative electrode of these tubes and has a name, —"cathode rays." In the upper air these corpuscles from the sun may well be considered to produce luminous effects, such as the auroral light. Arrhenius first suggested this theory of the aurora, but it is now quite generally adopted. Duncan's "New Knowledge," price $2, page 238, gives it in some detail. It is also to be found in Thomson's "Conduction of Electricity through Gases," price $4.

(9774) J. W. says: As a subscriber of your paper for a number of years, I take the liberty of asking a few questions in regard to the Corliss engine. First, what power would be developed with a 24 x 36 cylinder with 90 pounds steam pressure, speed 90 revolutions per minute? Also, 100 revolutions per minute; 115 revolutions per minute; 125 revolutions per minute? Same size cylinder and steam pressure to govern in each case. It has also been stated by one of our leading manufacturers in this city that the above engine equipped with an inertia shaft governor and double eccentric, running at a given speed per minute with 100 pounds steam pressure would develop 300 horse-power; while the same engine equipped with a double eccentric and an ordinary flyball Corliss governor would develop, with the same steam pressure and speed, 500 horse-power. To my mind this is absurd, but he is so positive, and a business man of some prominence, would you kindly give me your opinion? In other words, why should an ordinary Corliss governor give 200 horse-power more than an inertia shaft governor under the same conditions? What has the governor to do with the developing of power? A. The horse-power which an engine of any given size will develop at a given boiler pressure and speed will depend entirely upon the *point of cut-off*, or, in other words, upon the friction of the stroke during which steam is being admitted to the cylinder. It is possible to have the cut-off so early that the average pressure in the cylinder during the stroke will be nearly zero. On the other hand, it is possible to have the cut-off so late that the average pressure in the cylinder during the stroke will be approximately equal to the boiler pressure. The maximum economy with the Corliss engine is attained when the cut-off is about 30 or 35 per cent of the stroke; and the cut-off under maximum load should not be later than 40 per cent or 45 per cent of the stroke when an economical engine is desired. With cut-off at one-third of the stroke, the main effective pressure in the cylinder would be about 4-10 of the boiler pressure, or, in the instance that you mention, 36 pounds, and the horse-power at 90 revolutions would be

$$\frac{22 \times 24 \times 24 \times 36 \times 2 \times 36 \times 90}{7 \times 12 \times 3500} = 265 \text{ horse-power.}$$

At other speeds, the power would be in proportion to the speed; thus: At 100 revolutions, horse-power equals 294; at 115 revolutions, horse-power equals 339; at 125 revolutions, horse-power equals 368. At the steam pressure of 100 pounds, and the cut-off mentioned above, the horse-power would be 11 per cent greater. If the cut-off comes later in the stroke than estimated above, the mean effective pressure would be greater and the horse-power correspondingly greater. It is, therefore, perfectly possible that the statement made to you by the manufacturer to whom you refer is entirely correct. The range of cut-off with an inertia shaft governor is not nearly as great as the range which is possible with the ordinary flyball governor. The latter type of governor might easily permit a cut-off sufficiently late to allow the engine above mentioned, at a boiler pressure of 100 pounds and a speed of 100 revolutions per minute, to develop 500 horse-power. With this late cut-off, however, the engine would not be wroking with great economy.

(9775) E. E. asks: How is the focus of a concave lens determined? Is it the radius of a circle, or half the radius of the curvature? Please inform me as to both plano and double concave. A. All foci of concave lenses are virtual. For a biconcave lens of glass, whose index of refraction is 1.5, with the same radius of curvature on each face, the principal focal length is equal to the radius of curvature. For a plano-concave lens of the same glass, the principal focal length is equal to twice the radius of curvature. In these respects the concave and convex lenses agree, excepting that the focal length of concave lenses is negative. The formula for determining focal length of concave lenses is $\frac{1}{f} = \frac{1}{p} - \frac{1}{p'}$.

ELECTRIC LAUNCH MOTOR.—THE design in this paper is for a motor of unusual simplicity of construction, which can easily be built by an amateur at small cost. It is intended for a boat of about 24 feet over all and 4 feet 6 inches beam, drawing 18 inches, and is capable of propelling such craft at a speed of 7 miles per hour. Illustrated with 21 cuts. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 1202. Price 10 cents by mail, from this office and from all newsdealers.

NEW BOOKS, ETC.

THE STORY OF THE CONGO FREE STATE. By Henry Wellington Wack, F.R.G.S. New York and London: G. P. Putnam's Sons, 1905. 8vo.; 125 illustrations; pp. 643. Price, $3.50.

The present voluminous, but extremely interesting work is from the pen of an American who, as a student of mid-African affairs for the past seven years, and a close observer of the rapid progress toward complete civilization now being made in that part of the world, feels it to be his duty to lay before his countrymen the true and complete story of the conception, formation, and development of the Congo Free State. The motive prompting the writing of this book, which is of a character such as to have entailed much laborious and careful work, is to be found in the fact that during a period of several years there has been an organized campaign against the Congo Free State. The author, who is a Fellow of the Royal Geographical Society and a member of the New York bar, was in a position, because of a residence of several years in the United Kingdom, to observe the development of this movement. In the course of an interview with the King of the Belgians, the author frankly stated that he wished to have access to all the documents of the Congo administration office, for the purpose of writing an impartial book that would place the public in possession of the true facts regarding the affairs of the Congo. The King gave the author access to the offices of the Congo administration, where many weeks were spent in translating and copying documents. That the work is an impartial one may be judged from the fact that it is written by an outsider to the controversy, and that neither the manuscript nor the proofs were submitted to any person connected either directly or indirectly with King Leopold, the Congo Free State, or the Belgian government.

OUR STELLAR UNIVERSE. A ROAD-BOOK TO THE STARS. By Thomas Edward Heath. London: King, Sell & Olding, Ltd., 1905. Price, $2.

The author of this book, while converting for his own information the parallaxes of a long list of stars from seconds of arc to light-years, discovered a very suitable scale for stellar differences. After collecting all the information obtainable as to stellar parallaxes and magnitudes, he has written this small

volume in order to enable the general reader to appreciate the glory and magnitude of the stars. The book contains two stereoscopic views of the stars, which may be cut out and used in any stereoscope. It also contains, among other chapters, several on the Stars and Space; Our Stellar Universe; Stellar Magnitudes and Parallaxes; and the Sun Power of the Stars. As the author expresses it, his book is intended to be an "itinerary or road-book to the stars." Although he does not vouch for its accuracy, it is founded upon the best stellar parallaxes obtainable. The novel method of appreciating the distances is based upon Mr. Heath's discovery, that "if the distance which light travels in one year be represented by one mile, then the distance of the earth from the sun will be represented by one inch on the same scale." With this principle as a basis, it is possible to construct a model or diagram in which the solar system and the stars of known parallax can be shown in such a way that our minds are able to form a clear conception of the whole. This is attempted in the present volume, which has several diagrams worked out on this scheme. The book will be readily appreciated by the merest tyro in astronomy.

INDEX OF INVENTIONS

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AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

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