the primary circuit of an induction coil is broken a certain number of times in the course of a complete revolution of the drum. By means of a special device, the photographic paper is simultaneously impressed with the tracing of the cardiac movements and with two systems of parallel and equidistant straight lines at right angles to each other. The horizontal divisions correspond to intervals of time, the vertical divisions to the current strengths, and, therefore, to the energy of the cardiac contractions. In the accompanying reproduction of two curves recently recorded at the Marey Institute, the curve having large undulations represents the movements of a normal heart, while the feeble undulations of the other tracing were derived from a patient suffering from endocarditis.

The tracings which have been obtained by Einthoven and Bull show clearly the superiority of the new photo-electric method of studying cardiac movements. It is probable that physicians will soon employ the method regularly in diagnosis, and will become familiar with the curves characteristic of the various lesions of the heart which they have studied clinically. It is an important advantage of the method that the patient need not be moved to the physiological laboratory, for the currents can be conducted by telegraph wires from the vessels of salt water in which the hands are placed to a galvanometer at a distance. Einthoven's laboratory is thus connected with the Leyden hospital by a cable about one mile in length. The process of making the records is facilitated by telephonic communication between the two institutions.

Multiplication of Color Photographs by Contact Printing.

Various methods of multiplying autochrome photographs by contact printing have been described. The special difficulty of this operation is due to the fact that the sensitive films of the two plates are not in immediate contact, but are separated by the thickness of one of the glass plates. Hence, in order to produce a sharp copy, it is necessary to use a parallel or very slightly diverging beam of light. In practice, a bit of magnesium ribbon is burned at the mouth of a long narrow box, at the rear end of which the two autochrome plates are placed. In a recent issue of the Bulletin de la Société française de Photographie, M. Monpillard shows how the same result can be obtained by using a fixed source of light (Nernst lamp, incandescent gas burner, etc.) placed at the principal focus of a condensing lens. This arrangement produces a bundle of parallel rays, in the course of which the two plates are placed in contact with each other. On the same principle Landrieu has devised a method of reproducing autochrome photographs by contact printing with perfect certainty and clearness. The employment of a fixed source of light offers the great advantage of allowing the time of exposure to be regulated in perfect accordance with the character of the original plate. As it is always necessary to interpose a colored screen in the path of the beam of light, the use of a condensing lens alone would require the employment of a very large screen. In order to avoid this necessity Landrieu employs a complete projection lantern, including a condenser and an objective of so long a focus that the beam of light is not very divergent. In these conditions it suffices to place near the objective, either before or behind it, a color screen of small dimensions and of a tint depending upon the quality of the light. With a Nernst lamp of 700 candle-power a condenser of 4½ inches diameter, a suitable objective, and a color screen of the type called "Auto LN," the two autochrome plates should be placed at a distance of about 40 inches from the objective. The exposure varies from 8 to 12 seconds, according to the intensity of the original picture. The sharpness of the copy is practically equal to that of the original.

Electric Blast Furnaces.

The electric method for use with blast furnaces is being tried in Sweden by the Domnarfvet steel works, which is one of the largest in the country. In its general form and size, the electric blast furnace resembles the usual kind, except that the lower part where the metal is melted is of larger size than usual. As to the kind of current which is used, it is preferred to employ three-phase current at a tension of 40 volts, using a very heavy current of 9,500 amperes. At first an induction type of furnace was used, but the last form is an arc furnace using three electrodes. For the charge of the furnace there is used the proportion of 100 parts hematite and 18 of coke, but, if necessary, the coke can be replaced by wood charcoal. In certain conditions the electric blast furnace gives a product which has the same percentage of carbon as is found in steel, but it appears best to use the furnace to produce pig iron and then to refine this afterward. The cost of production depends mainly on the cost of current and the price of coke. Compared with the usual kind of blast furnace, the electric process consumes only one-third the amount of coke, seeing that in the first case the heat is furnished by the coke,

while in the electric furnace it is given by the current. The new process is a favorable one for use in Sweden, for current can be had at a low price, while coke is expensive and the electric method economizes the latter. The commercial use of the electric process depends, therefore, upon the relation between these two factors in any given region, and this differs widely in various countries.

LIGNO-CONCRETE: AN EARLY FORM OF REINFORCED CONSTRUCTION.

BY THOMAS PARKER.

Recently a report on reinforced construction work has been prepared by the engineer in chief of the harbor board at Rockhampton, Australia, speaking very favorably of the durable nature of the structure. This is a river wharf and was designed and carried out seventeen years ago by the writer. At that time no other reinforced concrete work of that type was known, and it was regarded as a pioneer in that kind of construction. The substantial nature of the work, after seventeen years' test, and the opinion of the inspecting engineer, that it will probably be as sound at the end of one hundred years as it is now, will give interest to the following description of the work.

For several years the timber wharves belonging to the city of Rockhampton, although built of the most durable hardwoods of Australia, with Muntz-metal covering to the piles, had been subject to the ravages of the teredo. One costly wharf literally collapsed and fell into the Fitzroy River, having been undermined by the well-known marine scourge which had honeycombed the supporting piles. As a protective measure, the device was adopted of driving piles on the front line of the wharf, as shown in the illustration, and inclosing these piles in monolithic cement concrete. The rock forming the bed of the river was excavated to form two grooves into which the concrete is tied. This concrete front wall is also tied to the land by piles driven into the river bank behind

LIGNO-CONCRETE WHARF, ROCKHAMPTON, AUSTRALIA.

connected with wrought-iron rods 1¼ inches in diameter. The main piles in the front are in couples at 10 feet distance longitudinally, on which are bolted upper and lower walling timbers to stiffen the initial timber structure before inclosing it with the cement concrete. The latter was composed of 6 parts of stone, gravel, and sand to 1 part of Portland cement, and laid successfully within a sheet-piled and canvas curtain. The concrete was mixed and filled into a canvas bag, and lowered down to the bottom, with the mouth of the bag downward, loosely secured by a cord, one end of which reached to the workman above water. When each bag of concrete reached the bottom, or surface of concrete work in progress, by pulling on the cord, the concrete was gently discharged while the bag was slowly hoisted from its resting place. By this method the mixed concrete was laid 18 feet below low water without washing out the cement. A return wall at each end was constructed in a similar manner, of reduced dimensions, to carry the wall to the land and shut out the tidal water from the back of the work. The space behind was then filled up with earth and gravel, and a timber decking laid on top to carry the traffic. Cast-iron fender pieces were fixed to the front of the wall, which thus presents a surface of indestructible materials to the river front.

The advantages of this new method of wharf building were claimed to be the following: Entire protection against the teredo, a substantial structure with a minimum thickness of concrete wall, secured by the hold of the driven piles in the rock and the tie rods to the solid land at the back. Also the avoidance of the objectionable spaces under the old form of timber wharves which harbor rats and filth; and a permanent structure at little more than the cost of timber structures.

It is stated in the Brass World that plaster of Paris will harden rapidly if 0.25 per cent of sodium bisulphate is added to it. The sodium bisulphate should be dissolved in the water used for making the plaster. The strength of the hardened mass is also stated to be increased nearly three times.

WILLIAM JAMES.

BY BENJAMIN GRUENBERG.

The popularization of psychology has exerted a tremendous influence beyond the application in the school room. We have developed a psychology of advertising soap, a psychology of selling mining shares and soliciting subscriptions to magazines, a psychology practically applied by the lawyer when addressing a jury, and an ecclesiastical psychology according to the principles of which sermons are written and funeral eulogies delivered. It seems to us now a matter of course that everyone should prepare himself for his work thoroughly, and that some of us should need to know something about "human nature." But most of us do not realize that thirty years ago there were no professors of psychology in this country, and that the recognition of psychology as something to be studied in a university had to be fought for very strenuously. And in this fight William James was the front and center.

To-day every normal school and every fourth-rate college must give its courses in psychology; while at the universities the researches into the workings of the human brain, as well as of the mind organs of lower animals, is being carried on with a thoroughness, a refinement of technique, and a profusion of valuable results that could not have been foreseen when the little anteroom at Harvard, Prof. James's workshop, full of jars and odors and disorder, was the first psychological laboratory in America.

He embodied to a remarkable degree, both the scientific and the metaphysical temperaments. His great book, which established his reputation in Europe as well as at home, "The Principles of Psychology," was published in 1890. Its popularity extended beyond the sphere of those who were professionally interested in the subject matter. The brilliant style, the rich humor, the constant allusion to everyday incident, made it a favorite with all who were ever introduced to its pages. It has been criticised for these very qualities. Probably nine-tenths of all our teachers who studied psychology at all before the close of the last century studied it out of James's book; and a majority of these same teachers conduct their work on a psychology that is entirely different from the psychology that James taught.

As a direct result of his studies in comparative physiology, James was forced to develop a system of psychology that is characterized to-day as "functional," that is, one that regards the mental processes of man or of any other organism as the outcome of the activities or functions of the living matter of the body, and especially of the living substance of the brain and nerves. This view, now justified by the comparative physiological and psychological studies of Loeb, Verworn, Goltz, Exner, and others, in turn follows from the biological principles that were worked out under the influence of the idea of evolution, made common property by Darwin, Spencer, Huxley, and their co-workers. Such is the force of tradition and our veneration for authorities, that the teacher reads James's chapters on "Habit" and "Memory," in which he insists that we have "memories, not memory," firmly convinced that the pupils are having their "faculties" trained. The new biological psychology, of which William James was the founder in this country, is distinctly opposed to the Aristotelean psychology of faculties. Older teachers who are not trained in modern science will do their teaching according to the gymnasium or training idea of education; while the younger teachers will try to educate a whole boy or a whole girl at a time, instead of separate "faculties."

For many years an investigator and teacher of a science, and for many years a student and teacher of philosophy, it was perhaps to have been expected that William James should have developed a new view of the world; but he modestly called his "Pragmatism" a "new name for some old ways of thinking." His philosophy of pragmatism, the doctrine that the test of truth is its workings or consequences, is indeed not an entirely new thing. Practically the same system has been worked out in this generation by a number of philosophers in Europe as well as in this country. But philosophical doctrines, although they may reappear from time to time, apparently the same old ideas, do in reality become modified by the other forces in society that influence human thought. And so the pragmatism of James is possible only because of the science of the nineteenth century.

Like every attempt to formulate in words a vision of the truth, this system of thought is subject to various misinterpretations that seem to be unavoidable. Men and women with a scientific habit of thought are just as likely to be impressed with the absurdities suggested by a bald statement of the idea as men and women with a metaphysical bent or with no mental bias at all. At the same time, the pragmatic philosophy does constitute a philosophy of life, notwithstanding what the professional philosophers may say to the contrary; and it is in perfect harmony with the methods of modern science. It is a simple matter to ridicule any *ism*; the difficulty in philosophy, as in relig-

tion or in politics, is to come to an understanding of what the other fellow really means.

In spite of the implications of his own work and that of his contemporaries in the field of physiological psychology, William James retained a strong leaning to metaphysics and to dualism. His pragmatism would perhaps justify a faith in the immortality of the soul, on the ground that such faith served as "a balm for men's souls;" but his scientific candor would resent a faith that was in conflict with direct evidence. Seeking reconciliation between the monism of science and the dualism of family tradition and temperamental predisposition, he found it in what he believed to be a higher synthesis—a conception of a pluralistic universe. This idea, like "the fourth dimension," is not easily explained because it is not easily pictured by the mind. But practically it means the rejection of the idea of the absolute.

The method of the scientist requires that we keep our minds open to new evidence; this means that our beliefs, our truths, are merely provisional, always subject to revision. But in a dynamic world the final truth can never be reached. Therefore, there can be for us no absolute truth. This is transcendental pragmatism. At first blush this suggests intellectual chaos, but it really is not as bad as it looks. At the present time this philosophy, without any name, is rapidly making headway among all classes of people. We are learning that law and order are possible politically without any monarchs. We are learning that moral conduct is possible without the absolute of "irrational sanctions." We are learning that many questions cannot be answered by *yes* or *no*. And we are learning that many questions that puzzled the ancients need not be answered at all. All these things indicate a decline of faith in the absolute. But with the passing of the absolute we come to recognize that there are many truths, not one; and these truths, like beauties and goodnesses, are always more or less. There is no absolute truth any more than there is an absolute beauty. What is good to-day was evil yesterday and may be evil again to-morrow. It is easy to say, and it has been said, that such doctrines are subversive of social order and morality. But a philosophical discussion rests upon the assumption that the participants are sincere. The libertine who seeks absolution or a salve for his conscience does not come to the philosopher.

The dynamic view of life and conduct implied in the philosophy of William James has been spreading, largely as the result of the general acceptance among thinking people of the doctrine of evolution; and is accepted by many who have never even heard of pragmatism or of William James. But to this man must be given the credit for a large share in the work of disseminating these ideas; for without teaching it formally, his psychology has carried the message to the teachers, and they, for the most part unconsciously, have passed it on to the rising generation.

What the estimate of the future will be cannot, of course, be anticipated. Already the famous "Briefer Course" is being superseded by textbooks written by some of the pupils of William James. But that the clear thought and deep human sympathies of the great teacher will have left a permanent impression upon our civilization, there can be no doubt.

A \$15,000 Prize for Aeroplanes.

Mr. Edwin Gould has offered, through the columns of the *SCIENTIFIC AMERICAN*, the sum of \$15,000, which is to be awarded for the construction of a heavier-than-air flying machine, equipped with more than one motor and propeller.

The conditions governing Mr. Gould's offer were published in the *SCIENTIFIC AMERICAN*, issue of July 30th.

The Aero Corporation, in charge of the international aviation meeting to be held this autumn, has made some tentative announcements. The opening date will probably be postponed to November 9th. Six foreigners have thus far entered for the Gordon Bennett Trophy. Latham, Le Blanc, and Labouchère come from France, Graham-White, Radley, and McArdle from England, to compete for the cup. The three American defenders will be selected by elimination trials. The sum of \$50,000 has been set aside for cash prizes. There will be three prizes of \$4,500 each for duration, speed, and altitude. Each of these grand prizes is to be divided into first, second, and third money, the winner receiving \$3,000, the second man \$1,000, and the third man \$500. There will probably be an altitude prize of \$5,000 or \$10,000 for the man who reaches an altitude of 10,000 feet. There will also be the usual prizes for duration, speed, and altitude, amounting to \$250 for each hour during the duration, speed, and altitude tests. A large prize will also be offered for cross-country flights, as well as prizes for passenger carrying, relay messenger service, slow flying, quick starting, and other feats. The aviators will share in the gate receipts, which may be from \$100,000 to \$300,000.

Correspondence.

NEW WORDS.

To the Editor of the *SCIENTIFIC AMERICAN*:

In the current issue, your correspondent, Mr. S. Cummings-Huet, desires "another word to replace that misnomer, manufacture, which we use to describe the process of making by machinery articles which were made by manus. We also need a word to describe type-written copy which is not manuscript.

Mechanism may be changed to mechastructure, mechastructure, etc., but motofacture, motofactory, motoproducts, motoproduction, seem to have good etymological basis.

The typewriter is a machine; why not motoscript, or script? W. STORER HOW, D.D.S.

Philadelphia, Pa.

THE ARGENTINE AND UNITED STATES DREADNOUGHTS.
To the Editor of the *SCIENTIFIC AMERICAN*:

I have read with interest your article comparing the latest American and Argentine dreadnoughts, and also the articles in *The Navy* to which your arguments refer. While agreeing with many of the points made, I think you have missed the real purport of *The Navy's* statements, namely, that generally speaking, the "Rivadavia" is a better fighting machine than the "Wyoming." This you practically admit to be true; but in plunging so far into detail as to make the basis of comparison on *full load displacement* instead of *trial load displacement*, the main points in favor of the Argentine vessels have been lost.

The real question is this: Can the "Rivadavia" and "Wyoming" be compared as *they are*? If so, then your arguments are lost. No two warships of different powers in the same class as to date, etc., ever have exactly the same displacement. The "King Edward" class in the British navy are always ranked with our "Connecticuts," yet there is 500 tons difference in their displacements. When battleships get up as high as 27,000 and 30,000 tons, 3,000 tons more or less is not as important as if 16,000-ton ships were being figured on. Therefore I maintain that the "Rivadavia" and "Wyoming" are directly comparable, each being a dreadnought of the latest design and built at the *same time*. Accordingly, *The Navy* is correct when it states that the private shipyard designers, Americans, assisted by a certain United States naval officer who is a leading factor in the shipbuilding company in question, have "put one over" on the Navy Department designers. In other words, the United States should now be building two 30,000-ton, 23-knot ships instead of two of 27,000 tons and 21 knots. It is easy to answer this, of course, and say that every year the ships are larger, but harbor and drydock facilities will soon check this. Your defense of our deficiency in speed is very weak, as there is, judging by past performances of American-built warships, just as much chance for the Argentine as well as the United States dreadnoughts to exceed their contract requirements. The greater radius of action which is obviously evident in the case of the "Rivadavia" is almost the most important feature of a battleship's fighting power. It means a great deal more than an inch or two in thickness of armor, or speedy construction, or cost, etc.

As to the turret arrangement, after all, the fact remains that no matter how small the bow and stern arcs of fire of the "echeloned" turrets of the "Rivadavia" are, she has only 15 degrees less in all the arcs of fire on broadside and 33 1/3 per cent more direct bow and stern fire than the "Wyoming." In general bow and stern fire this advantage decreases to about 50 degrees in the total arcs of fire. This unquestionable superiority of fire was not obtained at a sacrifice of height of gun position, in which respect the "Wyoming" is superior, and I think the next design will show both of these features combined.

The question of location of the central fire-control station is, as you state, still a matter of opinion, but whichever way the decision is rendered, a low, heavily armored position or the present skeleton masts, the Argentine vessels have the best, while ours are equipped only with the skeleton masts.

Finally, I would say as a matter of general interest that I have learned on fairly reliable authority that the name of the second Argentine dreadnought is "Acorazado."

HAROLD M. KENNARD.

Brooklyn, N. Y.

The "Polly," the oldest American merchant vessel, was recently in New York harbor discharging a cargo taken on board at Bridgeport, Conn. So lightly has time touched this vessel that, despite her 106 years, she remains in as good condition as most mercantile ships of one-tenth of her age. She is only 61 feet in length, and has only 45 tons net burden, but she has a notoriety which is much more substantial. Her former skipper and owner, Capt. Upton, armed his crew with axes and cutlasses, and few privateers enjoyed more successful cruises in 1812. The "Polly's" rig was that of a sloop, and her captures of British

merchantmen were many along the New England coast, until she was overhauled by the British frigate "Phœbe," when Upton and his ship and men were made captive.

Cold Storage Eggs in France.

According to Dr. Bordas, of the French council of public hygiene, the cold storage of eggs is rapidly increasing in France, and will soon supplant liming and the other processes now employed for preserving eggs. Dr. Bordas insists on maintaining a rigorous distinction between fresh eggs and cold storage eggs, although the latter are very superior to limed eggs. Five, six or even seven months of cold storage do not appreciably alter the appearance or odor of eggs, while lime water, acting for a much shorter period, makes the albumen slightly yellow and gives the egg the characteristic odor of lime. An egg which has been kept three or four months in cold storage is still in perfect condition to be eaten, soft-boiled, from the shell, but a limed egg of the same age is unfit for this use. After the fourth month of cold storage the air space of the egg becomes enlarged by evaporation, but the egg is still perfectly fit for pastry making and most culinary uses. In recent years, especially in the districts of Lyons and Bordeaux, French preserved eggs have suffered from competition with preserved yolks of foreign origin. For hygienic reasons it is desirable that cold storage eggs should be used by all bakers and pastry cooks.

The Harvard-Boston Aviation Meet.

The Harvard Aeronautical Society, which, although less than a year old, now has nearly 400 members, is promoting the first aviation meet in New England, and for that matter, the first meet of this kind of any consequence to be held in America up to the present time. The society has received the co-operation of President Lowell, of Harvard University, and of Mayor Fitzgerald, of Boston, and the Boston Globe has put up a cash prize of \$10,000 for the fastest flight over the water from the aviation field at Atlantic, out around Boston Light and back again, and thence to the State House and return—a total distance of about 25 miles. The society also offers a handsome gold trophy (the Harvard Cup) for the best record at dropping bombs upon a battleship outlined upon the field. In addition to these large prizes, first, second and third prizes of \$3,000, \$2,000 and \$1,000 will be awarded in the speed and altitude contests, and first and second prizes of \$2,000 and \$1,000 in the duration and distance events. In case of a new world's record being made in any of these events, \$1,000 extra will be added to the first prize. Other prizes to be awarded are as follows: Slowest lap, \$1,000 and \$500; quickest start, \$100 and \$50; accuracy, \$500 and \$250. The total amount of prize money to be won is about \$41,000.

The success of the meet has been assured by the engaging of such aviators as Brookins and Johnstone with their Wright biplanes; Curtiss and Willard with their Curtiss biplanes; Claude Graham-White with his Farman biplane and Blériot monoplane; A. V. Roe with his triplane—the only machine of this kind which has made successful flights; and three of the leading French aviators with their monoplanes. A number of new American aviators will make their debuts at this meet also. Clifford B. Harmon made a few flights during the first days of the meet. One of the novel machines entered is the Blériot monoplane of Stanley Y. Beach. This machine is fitted with the Sperry gyroscope for assuring its transverse stability. It is the first aeroplane upon which the gyroscope has been used for this purpose. A demonstration of kite flying will be given by Samuel F. Perkins, of Boston, who will send aloft Miss Emily Willard, sister of the aviator, suspended from a kite of large size and of special construction.

The meet lasts from the 3rd to the 10th instant. A full account of it will appear in our next issue.

The Current Supplement.

Mr. J. W. Titcomb continues his splendid and instructive paper on "How Fish Are Hatched" in the current SUPPLEMENT, No. 1810.—The marine suction producer-gas engines on the River Rhine are described and illustrated.—Death by lightning is described by John Knott.—The safety provisions employed by the United States Steel Corporation are discussed and illustrated by Mr. David S. Beyer.—To the question: "Is Matter Eternal?" Mr. F. W. Henkel replies in the terms of the modern physicist.—The sand blast and its many uses is the subject of an excellent article.—On account of the present activity in the rubber industry, due to the enormously increased demand for rubber, the presentation of a new substance which possesses a number of valuable qualities, and which can be used in many of the arts and industries where rubber and similar materials are employed, is of timely interest. Dr. F. G. Wiechmann describes such a substance of his own invention, which he calls "Protal."