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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

CONCRETE AND CRUSHED ROCK.

Evidence of the rapid increase in the use of concrete in engineering and architectural work is to be found in the great demand for, and increasing value of, what used to be known as "broken stone" and is now known as "crushed rock." There was a time, and not so very long ago, when the hand hammer or the portable crushing machine of moderate capacity were equal to supplying the demand; but of late years the call for this material has been so extensive as to warrant the construction of large plants equipped with machinery of special design and large power, capable of turning out several hundred tons of crushed rock per hour from each machine. In fact, it is likely that the production of crushed rock will become a specialized industry, with plants located conveniently to suitable quarries, and within reach of rail or water transportation.

The important effect which the growing use of concrete is having upon certain allied interests is shown by the fact that the sanitary district of Chicago has been negotiating for the sale of the enormous quantities of rock which were excavated during the construction of the Chicago drainage canal. This rock at present lies in huge banks, which extend for many miles parallel with the canal between Lockport and Lemont, Ill. The estimated amount of material suitable for crushed rock now lying in these spoil banks is 22,000,000 cubic yards, and the whole of it, of course, lies conveniently for transportation through the canal to Chicago. An offer of 10½ cents per cubic yard has been made for the rock as it lies in place, with the return of a certain percentage of the net profits from the sale of the rock after it has been crushed. Extensive as is the use of concrete, whether in the plain or in the armored or reinforced condition, we are to-day witnessing but the beginning of what may be termed the concrete age. This ever-broadening application of concrete is to be welcomed, provided care is taken to guard against careless construction or the introduction of cheap and fraudulent methods of work. If the day ever comes when concrete construction is carried on in the shoddy manner which characterizes much brick and stone construction of the present day, we shall be leaving a heritage of trouble and disaster to posterity, the measure of which it would be hard to foretell.

ELEVATION OF OUTER RAIL ON CURVES.

The elevation or, as railroad engineers call it, the super-elevation of the outside rail on curves is more important and demands more careful thought and attention than the maintenance-of-way engineer, the roadmaster, and the section boss are in the habit of giving to it. The danger of derailment due to the centrifugal force exerted by a train against the outer rail on curves may be greatly reduced by elevating the outer above the inner rail. Indeed, there is a degree of super-elevation corresponding to a given rate of speed which will theoretically relieve the outer rail of any side thrust, and cause the engine and cars to travel round the curve without any tendency to bear more heavily upon one rail than the other. If all trains were run at the same speed over a given track, it would be possible to put in this theoretical amount of super-elevation. As a matter of fact some trains would run slower than those for which the track was adjusted, and the slower trains would bear heavily against the inner rail. It is for this reason that engineers are in the habit of adopting a compromise super-elevation, too low for the fast train and too high for the slow train. We believe, however, that it would be better to put in the full super-elevation required for the fast trains, and this for the reason that the risk of derailment on the inside of a curve is a remote one, as is proved by the rarity of an accident of this kind.

On some of the roads of this country, where a fast schedule has to be maintained over tortuous track, the outer rail on some curves is super-elevated as much as 8 inches, and the riding on such track is wonderfully smooth and comfortable. It is, in fact, impossible to tell by the sensations of the body whether the train is running on tangents or on curves. On the majority of our roads, however, the track is not sufficiently adjusted to the higher speeds at which our fast trains are run, and we believe that to this cause, largely, are to be attributed the many derailments which occur. In this connection it is interesting to note the conditions on the curve at Salisbury, England, on which so many Americans recently lost their lives. According to information given at the coroner's inquest, the curve was an exceedingly sharp one, the radius being only of eight chains, or 528 feet. This would represent a curve of no less than 11 degrees, which is one degree greater than the maximum curvature which twenty years ago was considered to be the extreme limit even on our western railroads. That an 11-degree curve should have been allowed to remain in the main line of a road on which some of the fastest expresses in the world are run is to American eyes a very surprising fact. It is also surprising to learn that, although express trains were permitted to run without stopping, though at supposedly reduced speed, through Salisbury station and over this curve, the super-elevation of the outer rail was only 3 1-3 inches. It is not sufficient to urge as an excuse that the curve commenced at the station platform, and that a greater super-elevation was impossible. What was needed, and what is needed to-day at this point, is such a relocation of the line as will eliminate the curve, or at least reduce it to safe proportions.

The evidence of the guard and other employees shows that the train ran from Wilton, a few miles away, to Salisbury at a speed of 68.5 miles per hour, and there is no clear evidence to show that the speed was much reduced through the station. In fact, the guard stated that when the disaster occurred he was doing his best to attract the attention of the engineer. With a 50-ton engine running at that speed on an 11-degree curve, the centrifugal force was equivalent to about 25 tons applied at the center of gravity of the engine, which was about 5 feet above the rail. As the half width of the track was only 2 feet 4¼ inches, it is evident that the resultant of gravity and centrifugal force must have passed just about through the point where the wheel flanges bore upon the corner of the outside rail. The instant this resultant passed outside the rail, which might easily occur when the engine lurched against the rail, there would be nothing to prevent the whole mass from turning bodily over; and this was probably what occurred.

BRITISH MERCHANT MARINE AND THE COMMERCE DESTROYER.

Great Britain more than any other nation is dependent upon the existence and uninterrupted movement of her great merchant marine. In itself, and as the indispensable medium for carrying her vast commerce, the shipping fleet of the island empire is its most valuable asset. Therefore, it has been generally regarded as the most vulnerable point upon which to concentrate attack in time of war. So largely does Great Britain depend upon her over-sea commerce for food stuffs, that there would be no surer way of bringing that proud empire to its knees as a supplicant for peace than to capture, destroy, or drive from the high seas the ships that carry her food stuffs and the raw materials and finished products of her factories.

The recent naval maneuvers, in which practically the whole strength of the British navy was concerned, were planned with a view to determine just how great this peril might be, and to this end an "enemy's fleet" was organized which, though not large in numbers, was mainly distinguished by its combination of great gun power and high speed. Among the battleships were included the five new vessels of the "King Edward VII." class, and among the cruisers was the Atlantic squadron, which, under the command of Prince Louis of Battenberg, visited this country in the fall of last year. Although the commerce destroyer, as represented by our own "Minneapolis" and "Columbia," has ceased to be built, its place has been taken by the modern armored cruiser, which has all the speed of the commerce destroyer, in addition to good armor protection and a heavy battery of long-range guns. The Atlantic cruiser squadron, for instance, consists of ships, the slowest of which is of 23 knots maximum speed, while the fastest, the "Drake," made 24 to 25 knots for short distances when in chase of the enemy.

The "defending fleet" included twenty battleships of the Channel and Mediterranean fleets, besides several squadrons of cruisers, and the plan of the maneuvers was to dispatch a large number of merchant ships across the zone of war under convoy, the vessels being sent off in groups along one of several routes between Falmouth or Milford Haven and Gibraltar. The ships, whether their course lay northward or southward, converged off Cape Finisterre, which, of course, became the central point of defense. The method of defense was for the fleet to move in sections respectively to the south and to the north, each preceded by a wide screen of scouts and cruisers, the widely-separated ships of each screen being kept in touch by wireless telegraphy.

The nine battleships and cruisers of the enemy rendezvoused off Cape St. Vincent, where the vessels were formed in three great lines reaching east and west, with 30 miles between the individual ships of each line. The battleships formed the center line, while a line of cruisers was placed 120 miles to the north, and another line 120 miles to the south, the whole of this great network being kept in touch by wireless telegraph. The defending force, moving from Gibraltar and from Falmouth, quickly broke through the meshes of this net, two of the enemy's battleships and some of his slower cruisers being subsequently put out of action by the fleet from the south; the defending fleet from the north accounted for a third battleship and another large cruiser, while the "Magnificent," the last remaining of the slower battleships of the enemy, escaped by taking to the Atlantic. The enemy was left with five fast battleships of the "King Edward VII." class, and the enormous value of a homogeneous squadron of uniform high speed was shown by the fact that these vessels were able to break through the theoretically overwhelming force of the enemy, and steam up the channel with the defending fleet in hopeless pursuit.

The enemy's cruisers, forming the southern edge of the net, fought an important engagement with the defending cruisers off St. Vincent, in which all of the ships on both sides were severely handled and some vessels were practically destroyed. It is significant that most of the engagement took place at 6,000 yards range, at which the 6-inch gun is practically ineffective, and that the maneuvering was carried out at the high speed of 21 knots an hour. The value of speed in armored cruisers was shown when the enemy's squadron sighted the outer fringe of 25-knot scouts (a new type recently built) and gave chase. In this case the flagship "Drake" was able to raise her speed to 24.8 knots, with the result that she ultimately brought the destroyers within range, and they were ruled out of action. It is claimed, and very justly so, that the maneuvers have emphasized the value of an efficient engineering staff and have proved, once more, that upon the efficiency of the staff, and not upon the mere trial records of the ships, depends their final value when put to the supreme test of war.

On the other hand, too much importance must not be placed upon the escape of the attacking fleet and its ability to raid the maritime cities along the coast, and capture and destroy merchant vessels. Such damage would be local and temporary. Only by meeting and defeating the defending fleet in a pitched battle, a feat of which the enemy was quite incapable, could any decisive result have been achieved. Although the swift cruisers of the raiding fleet succeeded in doing considerable damage to the country's commerce, they were driven from the trade route which was selected for attack, and as a fleet were badly damaged and widely scattered. Altogether, the contention of the leading naval authorities that Great Britain's commerce can never be so absolutely crippled as to decisively affect the issues of war, would seem to be strengthened by the events of this summer's maneuvers.

THE EFFECT OF THE SEA UPON CLIMATE.

The enormous area of the sea has a great effect upon climate, but not so much in the direct way formerly believed. While a mass of warm or cold water off a coast must to some extent modify temperature, a greater direct cause is the winds, which, however, are in many parts the effect of the distribution of warm and cold water in the ocean perhaps thousands of miles away. Take the United Kingdom, notoriously warm and damp for its position in latitude. This is due mainly to the prevalence of westerly winds. These winds, again, are part of cyclonic systems principally engendered off the coasts of eastern North America and Newfoundland, where hot and cold sea currents, impinging on one another, give rise to great variations of temperature and movements of the atmosphere which start cyclonic systems traveling eastward.

The center of the majority of these systems passes north of Great Britain. Hence the warm and damp parts of them strike the country with westerly winds which have also pushed the warm water left by the dying-out current of the Gulf Stream off Newfoundland across the Atlantic, and raise the temperature of the sea off Britain.

When the cyclonic systems pass south of England, as they occasionally do, cold northeast and north winds are the result, chilling the country despite the warm water surrounding the islands.

It requires only a rearrangement of the direction of the main Atlantic currents wholly to change the climate of western Europe. Such an arrangement would be effected by the submergence of the Isthmus of Panama and adjacent country, allowing the equatorial current to pass into the Pacific. The gale factor of the western Atlantic would then be greatly reduced.

The area south of the Cape of Good Hope is another birthplace of great cyclonic systems, the warm Agulhas Current meeting colder water moving up from the Polar regions; but in the Southern Ocean the conditions of the distribution of land are different, and these systems sweep round and round the world, only catching and affecting the south part of Tasmania, New Zealand, and Patagonia.

WANTED: BRAINS TO DISSECT.

BY CHARLES STIRRUP.

It may not be generally known that all over the civilized world there is a strong demand for brains that are a little above the average in quality; not intelligence, or intellect, or genius, but, literally, that part of the human organism which is contained within the skull and is known as the brain.

Scientists who devote themselves to the study of comparative anatomy have for the most part nothing better to dissect than the brains of paupers and lunatics. These, however, leave much to be desired, and it is to the interest of the human family that the brains of cultured and learned people should be placed at the disposal of those patient and laborious men who are engaged in the vastly important work of unraveling the secrets of the working of the mind.

But it must not be supposed that a certain number of such brains are not forthcoming. Comparatively speaking, they are few, but, still, more numerous than most people imagine. In the great majority of cases they are bequeathed by their respective owners. On one occasion Sir William Fowler, the famous authority on comparative anatomy, in addressing an audience of cultured men and women, spoke of the difficulties he and his fellow workers had to contend with in having little else than the brains of people of low intellect to dissect, and went so far as to appeal to the audience to help science in this matter in the only possible way. On the conclusion of his address several members of the audience, including a few ladies, promised to bequeath their brains to him; and, it is said, proved as good as their word. More than one man of great eminence has regarded it as something in the nature of a duty to do this in the interest of science. Prof. Goldwin Smith, for instance, some time ago formally willed his brain to Cornell University.

Some remarkable brains have been sold, not given. An Englishman who calls himself Datas has disposed of his to an American university for $10,000. He is a man of little education, and for many years worked as a coal miner. But he has a marvelous memory, especially for dates, and is now earning a handsome income on the music-hall stage. Any member of the audience may ask him the date of some occurrence, and is answered instantly. It is considered that his brain must show some very unusual development, and there was not a little bidding to secure it after death.

It stands to reason that the brain of a man of intellect offers a much richer field for observation than the brain of a pauper or some other human derelict. The brains of great men vary very much; more, in fact, than do those of nonentities. It is found that men of encyclopedic mind have large and heavy brains —Gladstone had to wear a very big hat—with an enormous bed of gray matter and numerous convolutions; on the other hand, men whose genius is concentrated upon one line of thought are of small brain and, consequently, have a small head. Newton, Byron, and Cromwell belonged to this class, and each had a small head. Yet many people imagine that this is a sign of small mental capacity. A visitor who was shown the skull of Cromwell was so disappointed at its size, that the caretaker of the relic endeavored to console him by saying that this was the skull of the great Roundhead when he was a boy. Prof. Symes-Thompson told this anecdote in a recent lecture, and he also mentioned that Newton was so small when born that he could be put inside a quart pot.

A SEVERE EARTHQUAKE IN SOUTH AMERICA.

Shortly after 7 o'clock, on the evening of August 16, the city of Valparaiso, Chile, was demolished by an earthquake as severe as that which destroyed San Francisco April 18. The earthquake shocks, of which there were several, were recorded by seismographs in Washington, D. C., Florence, Italy, and at Newport, Isle of Wight. The record made at the last-named place was recorded by the instruments of Prof. Milne, the well-known seismologist, and they show an earthquake of long duration, lasting more than five hours. The first record of the earthquake by Prof. Milne's instruments was at 12:24 A. M., August 17, by Greenwich time. This corresponded to 7:15 P. M. of August 16 at Valparaiso. On developing the photographic films on which the subsequent record was made Prof. Milne found that his first record was entirely confirmed, and he was able to determine, from the interval of time between the preliminary tremors (which come through the earth) and the large waves (which travel around its surface) that the earthquake occurred some 6,000 miles away, probably on the coast of South America. Although telegrams indicate that the greatest disturbance was at Valparaiso, Prof. Milne believes that the shock was equally great along the coast, some distance north of that city, which is a classical spot so far as earthquakes are concerned. In 1835 a thousand or more miles of coast line were permanently raised a considerable number of feet, while in 1868 Iquique was destroyed, chiefly by large waves which not only damaged property but which also carried the American warship "Wateree" about half a mile inland. In 1877 another inundation resulting from an earthquake carried the same vessel nearly two miles further inland. During the last ten years, according to Prof. Milne, the southwest coast of South America has remained quiescent, and there have been many more disturbances upon the western coast of North America than in this region. These disturbances culminated in the great earthquake of April 18, which destroyed San Francisco. The present earthquake, from all indications, was quite as severe as that experienced in California. It did not occur, however, altogether without warning, as early in the present year there were a number of earthquake shocks felt throughout the republic. On March 27 the town of Raucagua experienced thirty slight shocks in a single night, and on April 24 several severe shocks were felt at Valdina. These did little damage, but greatly alarmed the people. On May 5, at Arica, a maritime town through which the trade of Chile is carried on with Bolivia, a violent shock occurred. Communication with Valparaiso is practically cut off save by one or two lines of cable extending up the western coast of South America. All the telegraph wires across the South American continent have been shaken down by the disturbance, which seems to have been general throughout Chile, and which was felt even in some parts of the Argentine Republic. A repetition of the San Francisco disaster occurred when the ruins of the city caught fire. Nearly all of the business houses and many of the residences on the hills at the back of the city were either shaken down or burned. The loss of life, at the present writing, has not been determined.

A curious fact in connection with the earthquake is that the seismograph on Mt. Hamilton, at the Lick Observatory, Cal., shows no record of any earthquake shock. This instrument is located in the so-called earthquake belt extending down the western coast of North and South America and around the Pacific Ocean where it takes in Singapore, Japan, and the Aleutian Islands. The seismograph located in this belt would be expected to receive distinct vibrations. The seismograph at Washington recorded both east-and-west and north-and-south vibrations of considerable extent. That at the Johns Hopkins University had the needle thrown off the recording cylinder, so violent was the shock, while the seismograph at Victoria, B. C., also recorded a shock not so severe as that felt at San Francisco last April, but which was, nevertheless, quite prolonged. The Chilean earthquake doubtless is the result of changes in elevation of the earth's crust due to changing conditions within, and in all probability these changes are the outcome of those earlier ones which produced the California earthquake.

THE NICKEL ORE MINES OF CANADA.

The mining of nickel ore in America has its center in the vicinity of Sudbury, Ontario, where the annual output has increased very rapidly within the last two or three years, owing to the extensive development of the deposits. While the existence of the ore has been known for over fifty years, only recently has this resource been exploited on an extensive scale. The annual product at present aggregates about 5,000 tons. Up to the present time, however, not over 50,000 tons have been taken from the mines, which gives an idea of the small quantity of this metal produced in comparison with iron, copper, and tin.

Ores of nickel are more evenly and abundantly distributed over the world than is generally supposed, but only in a very few countries are the deposits of such dimensions as to warrant their development as working mines, and at the present time the mines of Sudbury and New Caledonia produce about the whole supply of nickel. Canada is the largest producer in the world. The Sudbury nickel field has long been known as the most important source of that metal in America, if not in the world; but the work of the last three years has brought out more and more strikingly the unique character of this mining region. It has been proved that all the ore deposits of any economic importance are at or near the outer margin of a huge laccolithic sheet of eruptive rock a mile and a quarter thick, 36 miles long, and 17 miles wide. This sheet is now in the form of a boat-shaped syncline, with its pointed end to the southwest and its square end to the northeast. The rock composing the sheet is norite at the outer and lower edge, merging into granite or granodiorite at the inner (upper) edge. The ore bodies are round the margin of the norite, or along dike-like offsets from it, and have evidently segregated from the rock while still molten, though they may have undergone later rearrangement.

Nickel was first discovered at the Wallace mine, Sudbury, in 1846. In 1856 attention was again drawn to the subject by the finding of nickel and copper six miles north of Whitefish Lake, and less than half a mile southwest of the main pit of the Creighton mine, probably the largest deposit of nickeliferous pyrrhotite in the world. The discovery evidently was not deemed of much importance, as it was soon lost sight of. But the construction of the Canadian Pacific Railway through that region aroused such interest, that in less than ten years from the opening of the road all the mines which are now operated were located.

The industry was at a standstill for about a year, when the Canadian Copper Company, which has expended a large amount in the development of the Sudbury deposits, was organized with a capital of $2,500,000. This company opened Stobie, the Copper Cliff, and Evans mine, while investigations were made which proved the existence of very extensive veins. The Creighton mine was opened in July, 1900. It is undoubtedly the largest in the district, and from the very beginning of operations has produced large quantities of almost pure sulphides, with little or no rocky admixture. It is especially valuable as carrying a large percentage of nickel, with a very much smaller percentage of copper. The mine is situated about six miles in a straight line west of Copper Cliff station. The ore when mined is carried over the Manitoulin & North Shore Railway to Clara Bell Junction, where connection is made with the railway owned by the Canadian Copper Company.

The Creighton mine is at present the main source of supply, and with its equipment allows for a production of between 500 and 600 tons of ore per day. The old or original Copper Cliff supplies about 1,000 tons of ore per month, obtained mainly from the thirteenth and fourteenth levels, the latter workings being 1,052 feet below the surface, but even at this depth the ore body shows no serious diminution either in size or richness. No. 2 mine and the Frood (No. 3) complete the list of mines from which at present the supply of ore is drawn. The mines of the company not in use at present must not all be considered as having been permanently abandoned, but the openings now utilized produce an ample supply of the sulphide material of the various grades suitable for smelting.

The remarkable increase in the production of this metal in the Canadian district is largely due to the improved processes which have been invented for reducing the ore. At the smelters in the United States and Canada electrical apparatus has been employed, by which the metal can be secured at a much smaller cost than in the past, consequently it can be placed on the market at a much lower price, and is being utilized in various industries, where in the past its sale has been confined to a very limited market.

In a paper read before the Académie des Sciences, Messrs. D'Arsonval and Bordas show the advantages of using low temperatures in chemical work. The use of low temperatures is of great value for the separation of different bodies, either by solidification or by vaporizing. We need only to choose the right difference between the temperature, according to the nature of the bodies to be separated. Without going into details, we may mention an easy method by which in a few minutes many operations can be carried out, such as distillation of alcoholic liquids, drying of easily-attacked substances, collection of volatile products, etc. A primitive alembic is formed by connecting two glass vessels of the desired form and volume by a T-tube provided with a stop-cock. One of the vessels forms the boiler or dryer and contains the mixture to be separated, while the second vessel serves as the cooling or condensing chamber. We first make a vacuum in the chambers by the mercury pump, and after this the boiler is heated by placing it in water at 15 deg. C., for instance. The cooling chamber is plunged into liquid air, or simply into solid carbonic acid mixed with acetone. In the analysis of wines, for instance, we obtain at the same time the alcoholic products on the one hand and the extractive matter corresponding to the vacuum extract. In the drying of flour, albumenoids, fats, etc., we have the dry product and also collect all the moisture which can be weighed. Thus we have in a few minutes and without danger of destroying the substances, a series of analyses which might require days and even weeks by the usual methods. By regulating the temperature of heating the boiler, we also control the nature of the distilled product. Thus, when keeping the boiler at —80 deg. C. and the cooler at —191 degrees, we were able to take a volatile product from gasoline which has a remarkable resistance to cold and does not freeze at —200 deg.