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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.

SPEED AND SAFETY IN RAILROAD TRAVEL.

In another column of this issue we publish a letter from a correspondent who proposes, as a safeguard against the perils of railroad travel, that the speed of trains should be regulated by legislation, no train being allowed to run above a speed of forty miles per hour. This suggestion is made as presenting a more effective safeguard than that offered by a correspondent in our issue of January 20, who believes that the use of block signals and the automatic stop is the best solution of the problem of combining high speed and safety. There can be little doubt that, if all things be considered, the best compromise of the several conflicting interests which have to be considered in determining this question, is that of combining high running speed of trains with the automatic block signal and the automatic stop. For it is certain that an attempt to restrict, by law, the speed at which our railroad trains shall be run, particularly if the limit were set at forty miles an hour, would not only retard the progress of our whole system of industrial life, but would so far limit the capacity of our railroads that the lines would become congested, and the risk of accident be proportionately increased.

Our long list of railroad fatalities and accidents is not due to the high speed of trains; it is not due to the failure of the block signal system on such lines as use it; but it is due in part to the fact that enginemen play fast-and-loose, and in many cases are encouraged to do so by the management, with the fundamental principle upon which the block signal system is built up. This fundamental principle is that the commands of the semaphore arm or the colored light are absolute and final; that whether they say "stop" or "proceed," there is no possible appeal from their commands; that nothing is left to the discretion of the engineer, who must obey with the most literal obedience.

If the block signal were permitted, in the operation of trains, to exercise absolute authority, we believe that the percentage of accidents would at once be very largely reduced. As it is, however, that usually excellent trait of our national character which leads us to believe that nothing is so perfect but that it can be improved, has, in the case of the block signal system, led us astray; and in the attempt at improvement, we have robbed it of much of its value. On many roads the engineers are permitted to use their discretion by passing a signal and proceeding cautiously, the object, of course, being to save time by keeping the traffic moving forward. If we would secure the full benefit of the block signal system, this discretionary power should be removed from the engineer.

Furthermore, it may happen that even when the block signal is strictly obeyed, various accidents, which need not be recapitulated here, may prevent the engineer from stopping his train according to the signal; and it is in order to eliminate, as far as possible, these errors, due to the "human element," that the automatic stop has been introduced. Its advantages are so many and so obvious, that one would have thought that this device would have met with quick recognition, with universal recognition, we might say, on those roads which make use of any kind of an automatic signal system. Although various disadvantages have been urged against it by those who are responsible for keeping the traffic moving, we believe that the chief objection rises from the same considerations that led our railroad men to rob the block signal of its proper authority. They look upon the automatic stop as one more hindrance to that unimpeded movement of the trains, which is the prime object of the superintendent and his train dispatcher. We do not believe, however, that the ultimate effect of this device would be to hinder the flow of traffic. On the contrary, if the block signal were made more authoritative, if its commands were backed up by the automatic stop, we should rather be prepared to see the speed of trains steadily increase, as a direct result of the lessened risk of accident.

SUPERHEAT AND BOILER PRESSURES.

It is surprising that the advantages arising from the use of superheated steam should not have led to its earlier use on the locomotive; for it is only during the past two or three years that the superheater has begun to establish itself in locomotive practice. This development we owe chiefly to the Germans, who, with their characteristic thoroughness, are just now paying particular attention to the question of locomotive efficiency. The advantage of the use of superheated steam is that, by preventing cylinder condensation, it renders it possible to obtain from a simple locomotive an economy that compares favorably with that of the compound locomotive. It also permits of the use of a lower boiler pressure without any appreciable sacrifice of economy. This fact should render the superheater particularly attractive to the American master mechanic, to whom the high pressures which are now common are a source of increasing trouble and anxiety.

The great increase in boiler pressure has been one of the striking features in the recent development of the American locomotive. The most rapid increase took place during the decade, 1890 to 1900, when the pressure rose from 160 to 200 pounds to the square inch, several roads making use of the latter pressure. During the past five years 200 pounds has become common, and on some locomotives the pressure has risen to 210 pounds to the square inch; indeed, the writer has ridden on one make of compound, the needle of whose pressure gage was maintained at over 220 pounds to the square inch.

The increase in boiler pressure, like the increase in heating surface, has been due to the ever-present demand for greater power; but as far as the gain in power due to higher pressure is concerned, it has been secured at the cost of several disadvantages, such as increased leakage loss, a marked increase in boiler repairs, and a decrease of earning capacity due to the greater time spent by the locomotive in the repair shop. Now the introduction of the superheater offers a way of escape from the dilemma, a fact which is dwelt upon by Mr. H. H. Vaughn in a paper in the Proceedings of the Master Mechanics' convention, in which he states that, with the proper amount of superheat, it will be possible to return to pressures of 175 pounds or even less without loss of economy.

FORESHORE PROTECTION WITH CHAIN-CABLE GROYNES.

The experiments which are being carried out in Ireland with a novel method of protection against sea erosion, by means of cable groynes, devised by a Dublin engineer, will interest every government that is confronted with the problem of protecting its foreshores. In this system heavy chain cables are employed, to which are attached thorn bushes, or other suitable materials. The chains are laid at right angles to the foreshore, and at the sea extremity are held in position by means of concrete blocks or other suitable anchorage, while the shore ends are secured by means of strong iron pins driven in between the links of the chain. When a light cable is utilized, it is held in position at intervening points between the two extremities by concrete sinkers. The cable is then freely covered with trees, bushes, and so forth, which catch the sand, gravel, and shingle. These groynes are found to accommodate themselves easily to the contour of the seabed.

A few months ago ten of these groynes were erected on the foreshore at Bray, near Dublin. At this point the shore line faces due east, and the conditions are very unfavorable to any protectional devices. The shore is very steep, and there is a triple line of railroad along the shore, protected by a seawall, which is constantly in danger of being undermined. On a stormy day, with the wind dead on shore, the waves wash right up to the wall at low water, and there is a continuous travel of heavy shingle, gravel, and sand, the marl being exposed and subjected to continual erosion through the sawing action of heavy traveling detritus.

With a view to testing the efficiency of the chain groyne system, which is inexpensive to install, the railroad authorities arranged for these ten groynes to be constructed on this principle. The groynes are each about 100 feet in length, commence at mean sea level and extend beyond ordinary low water. They are pinned down to the marl with strong iron bars pointed and capped. They are placed about 130 feet apart. They were installed before the last equinoxial gales, so that the efficiency of the system was submitted to a severe test. The gales raged with great fury from the northeast, but failed to dislodge the structures. Considerable quantities of shingle, sand, and gravel, however, were brought in and still remain, the depth of reclamation at points ranging from 4½ to 5 feet.

The system has established its value, and already it has been decided to apply it to other parts of the British coast where other systems of foreshore protection are either impossible or difficult to carry out. It is anticipated that those at present in position will be carried further out to sea, so as to offer a greater measure of protection.

The installation of groynes upon this method certainly possesses many advantages. The flexible hedge is very adaptable to the inequalities of the seabed, while should it by any untoward circumstance be carried away, it cannot be lost owing to the shore anchorage. Furthermore, they can easily be removed from one point to another more advantageous if desired. The cost of construction is less than that of any other groyning system, while they can be placed in position much more expeditiously. They cannot be impaired by the ravages of the shipworm, are inexpensive to maintain, while it is impossible to destroy the main portion of the structure. It is certainly possible to carry the groyning farther seaward than by any other system, and thus influence the travel of material over areas far greater than has heretofore been possible. The developments and results of the installations are being closely followed by continental engineers, since there are many points around the European coast line demanding protection from the heavy sea erosion now taking place, but where the exigencies do not permit of any of the usual groyning systems being erected.

ELECTRIFYING THE ST. CLAIR TUNNEL.

The announcement was recently made that electric locomotives were to be used in conveying passenger and freight trains through the St. Clair tunnel, and a contract has just been closed for the complete electrical installation, including six locomotives fitted with Westinghouse single-phase motors. This change of motive power is due not only to the difficulty of ventilating the tunnel, but also to the congested condition of traffic at this point. The St. Clair tunnel consists of a single tube about 21 feet in diameter, and over a mile long, with approaches which make the entire tunnel line over 3½ miles long. When the tunnel was built, to provide for ventilation, a pair of tubes were extended from the center of the tunnel to the entrances, where they were connected to large blowers. Evidently this system of ventilation has proved inadequate, for quite recently a serious accident occurred, when a freight train broke in two in the tunnel, and several lives were lost by suffocation in the foul air before the stalled section of the train could be drawn out.

The congestion of traffic at the St. Clair tunnel is due largely to the fact that the freight trains arriving at this point are too heavy to be hauled through by a single locomotive. Consequently, the trains must be divided, and this involves considerable delay. While the approaches to the tunnel are double-tracked, there is only a single track in the tunnel proper, and this also contributes to the delay of traffic. The electric locomotives will be powerful enough to haul through trains of 1,000 tons, this limitation being due entirely to mechanical considerations; heavier trains may be conveyed through the tunnel with a locomotive at each end.

The adoption of the single-phase system is interesting as showing the trend of electrical engineering. While engineers abroad have been experimenting with the alternating-current motors, we in this country have clung to direct-current systems, because multiple-phase currents require a triple trolley, and the motors do not possess the speed-torque characteristics of direct-current motors. Recently, however, the development of the single-phase motor has removed these objections to alternate-current systems, and we now have a motor which combines the advantages of the alternating-current transmission with an efficiency favorably comparable with that of direct-current motors.

THE ELECTRIC FUSION OF GLASS.

An exhaustive study has been made by M. Bronn, of Paris, of the numerous types of electric furnaces constructed for the production of glass, and his conclusions have recently been published in a technical contemporary (Bulletin de la Société d'Encouragement) from which we cull the salient and most interesting features.

Most of these furnaces are of the arc type, which, it is pointed out, have (among others) the disadvantage that there is considerable loss by radiation; in addition to this, when carbon electrodes are used, these latter throw off carbon dust. This latter becomes mixed with the glass, more or less, as its quantity increases with the length of the arc. Endeavors have been made to conquer this drawback by adding oxidizing materials to the raw ingredients, but so far with no great meed of success. Experiments have been carried out with metallic electrodes, but it was found that brass melted, while iron became magnetized and was drawn into contact. In some systems the arc is produced above the glass, an electro-magnet being used to deflect it against the material. In this way certain advantages are secured, but the pointed form of arc raises the glass to a high local temperature, and frequently burns through the side of the container. Tests made with furnaces with this kind of arc show that from 4 to 6 kilowatt-hours are requisite to produce 1 kilogramme (2 pounds 3¼ ounces) of molten glass.

The glass was found to contain much more silicium than the ordinary mixtures, so that this electric furnace should be useful if glasses of this kind are desired; it would be too expensive for ordinary purposes, however. Another furnace, which has some advantages over the arc type, is that in which powdered carbon or cryptol is used as the heating material. In these the ingredients to be fused are placed in a container, which is then surrounded by the resistance material, thus insuring an efficient heat insulation, while at the same time considerably reducing the radiation losses. The resistance material must not be packed in tightly; the grains should also be of uniform size, and evenly distributed round the crucible. If required, the furnace may be arranged in such wise as to produce a higher temperature at one part than at another. One difficulty with this type of furnace lies in the high current intensity employed, but this can now be regulated, thanks to the invention of a suitable regulating rheostat, consisting of an insulated cylinder filled with the powdered material. A block of carbon at the bottom forms one electrode, while the second consists of a rod of carbon, which is pushed down among the loose material. The conducting mass may be distributed around the crucible in several ways; in some methods, for instance, triangular strips of carbon are placed in contact with the crucible with a view to concentrating the current at certain points. In this way the glass may be fused at low temperatures as compared with the temperature of the arc. The furnaces may also be regulated to give any temperature up to 1,600 to 1,700 deg. C., with a precision of from 10 to 15 per cent. The potential employed in connection with these experiments was about 100 volts.

SOME RECENT DISCOVERIES IN OCEANOGRAPHY.

The superficial area of the sea is two and a half times larger than that of the earth, while its mass or volume is enormous. Supposing that the basin holding the seas had been emptied at the time when Jesus Christ was born, and assuming that some enormous river had been allowed to run into it at the rate of 1,093 cubic yards per minute, the basin would still be empty, as it would require a total period of 600 years more before the seas would attain their present level. As may well be conceived, such a body of water must conceal many extraordinary things—but this is a possibility which has attracted attention only within comparatively recent times. The study of the earth itself has been attended with lesser difficulties, but we are now so familiar with our globe that its continents and islands are beginning to pall upon the curious mind, so that more attention is being given gradually to the ocean.

Two of the most prominent oceanographers of modern times are the Prince of Monaco and M. J. Thoulet. In 1899, the Geographical Congress, which met at Berlin, appointed a committee to prepare and publish a bathymetric map. As the necessary funds were not available the Prince of Monaco generously came forward and offered to take all the expenses upon himself, and the map was duly prepared in this way, under the auspices of Messrs. Sauerwein and Tollemer.

This valuable map has just been published and a copy was presented quite recently to the Académie des Sciences. It clearly shows the actual state of our knowledge regarding ocean depths, and the outline or profile of submarine lands, all the data being based upon soundings so far taken by hydrographers and oceanographers of all nations. Moreover, it also indicates the composition of submarine soils.

The map prepared and issued by M. Thoulet is one of the French coast (the submarine portions, of course), up to a distance of six miles from the shore; it shows the depths and—what is an entirely new feature—the lithologic composition of the whole zone in question, and indicates whether the ocean bed consists of mud, sand, stone, shell, rock, or algæ, etc. Devoted as it is merely to a fraction of the ocean, this map is much more detailed, while that of the Prince of Monaco is more a general bird's-eye view of the whole.

So far, but little is known about the bed of the ocean, but a few broad features may easily be picked up very soon, so that after a study of the Prince's map it is not difficult to translate the different shadings of color into differences of altitude, etc.; the student will then promptly discover that there are very many features of resemblance between the earth above and that below the bosom of the vasty deep. In fact, one is practically a replica of the other, both possessing hills, plains, mountain peaks, valleys, ravines, etc. The Atlantic Ocean, for instance, covers two vast valleys; one of these passes between the Cape Verde islands and the Azores, and is of great depth. It runs close up to Europe and comes to an end close to the British Islands, where a ridge or crest of land separates it from the basin of the North Sea. The other valley runs in the main parallel to the first, from which it is separated by an elongated strip of land of which the Azores form a super-marine continuation. This strip does not exceed a depth of 9,850 feet, while its height amounts to 6,560 feet. The first valley, like its *confrère*, is also very deep, its bottom being situated at a depth of nearly four miles below the surface. Passing along South America, and leaving the Bermudas to the left, it passes along Newfoundland and Labrador, finally ending just south of Greenland. The sub-Atlantic landscape thus consists of two vast parallel valleys, separated from each other by a range of mountains. Further north the land lies higher and the sea is, relatively speaking, shallow. Between Greenland and the Continent, close to Iceland and the Channel Islands, there is a huge plain free from any depressions worthy of mention. It is quite clear that at one time England was connected to the continent.

The greatest ocean depths, however, are not found in the Atlantic, as there are veritable abysses to be met with on the other side of the globe. Close to New Zealand the water attains a depth of five and a half miles in the Kermadec and Tonga ravines, which in themselves attain a height of 29,530 feet, while they are separated from each other by a chain of mountains of 9,850 feet height. There is also the Aleutian ravine, which reaches a depth of 23,000 feet. Mostly, sub-aqueous scenery is monotonous; there are no abrupt declivities or precipices, excepting in the vicinity of the coasts or near islands of volcanic formation, everything being rounded off and smoothed down by the action of the water. Close to the land there is somewhat more variety. The European plateau, for instance, slopes gradually away down into the depths, and a fair view can be obtained there, provided a maximum depth of 1,300 feet be not exceeded. At first, abundant vegetation and animal life are met with, but below the depth mentioned the scene changes; first, the light grows dimmer and dimmer, and the deeper we descend the lower does the thermometer fall, except in the case of the Mediterranean, where the temperature is, relatively speaking, high, as this sea is contained in what is practically a closed basin. In the Atlantic, by means of special bottles invented by Dr. Richard, one of the Prince of Monaco's collaborators, the temperature of the water was taken for a depth of 19,686 feet. The surface temperature of 68 deg. fell to 38 deg. at a depth of 6,562 feet. "After 2,000 meters" (6,562 feet), says Mr. C. Sauerwein, another of the Prince's collaborators, "the temperature falls but slowly as greater depths are attained, the cold being practically uniform and not subject to any changes of season."

Cold, darkness, and monotony—such are the characteristic features of the ocean bed. The composition of the floor itself is the only thing that changes, though this is only the case close to the coast, as no alteration (or very little) seems to occur at great depths. Investigations made with drags, dredgers, sounding apparatus, and the like, have shown that it is an error to assume that the bed of the ocean is covered with sand, as this latter is essentially a coast formation only found in comparatively shallow water, close to the shore. Mud begins to take its place the further we go afield—mud, or rather, ooze. Its origin varies considerably; a part consists of the alluvial deposits brought down by rivers. This ooze is of various kinds. Blue ooze is found close to schistous coasts, and its hue is imparted to it by organic substances and iron pyrites; it covers the floor of the Mediterranean and of the Arctic Ocean. Red ooze is merely the blue variety changed in color by the peroxidation of the iron; it is also formed of the alluvial deposits brought down by rivers flowing through land rich in iron, such, for instance, as the Congo and some rivers in Brazil. Green ooze, finally, owes its color to glauconite; it is found along rocky coasts where there are no rivers. In many places the sand or ooze is mixed with volcanic elements originating from terrestrial and submarine explosions. The inorganic world, however, is not the only source from which the ocean bed receives its supplies of material. The remains of organic creatures also contribute no mean share. The upper strata of the sea swarm with teeming animal life—algæ, crustacea, eggs, larvæ, etc.—of all kinds, which die daily in thousands and slowly sink downward to the lowest depths of the sea, thus forming a continual rain of corpses of algæ, diatoms, *et hoc genus omne* which descend from heights far exceeding those of Mt. Everest (33,756 feet) and other lofty terrestrial peaks. Protozoidal forms, foraminiferæ and radiolariæ (over a million of which would not weigh an ounce, but which are so fertile that one specimen can produce 70 million direct and indirect descendants in four days) also play a highly important part in this work. Due to their shells, the foraminiferæ form large quantities of calcareous deposits. The globigerinæ and orbulinæ (members of this family) form a special ooze which is found in the bed of the Atlantic, while the radiolariæ form silicious deposits which abound in the Pacific and Indian oceans, where a special kind of ooze is also found, viz., the pteropod ooze composed of the shells of pteropod mollusks which is found at the bottom of the Atlantic between Africa and America and near the Azores. These oozes, however, are not permanent, but merely represent a phase or stage. Red, blue, and brown clay is the only permanent compound; it is soft, greasy to the touch, and contains from 1 to 20 per cent of lime, a little vitrifiable earth, and organic remains. The oozes referred to above gradually turn into red clay, which thus becomes the final tomb of all that has lived, moved, and had its being in the sea.

A good deal more might be said about the strange beings which inhabit deep waters, feeding upon the bodies and excrementa continually raining down from the upper layers of the waters. But oceanography is not a pursuit of mere curiosity; its aims lie deeper and are of greater value, viz., the determination of the configuration and lay of submarine lands so as to facilitate the laying of cables, the discovery of spots where submerged peaks lie so near to the surface as to be a menace to passing ships, and the sounding of vast abysmal depths. Further than this, the sea and the sun are two great factors determinative of climate, and this is another reason why oceanography cannot fail to be of the greatest interest and value to mankind.

Meantime, the publication of the new maps in question has proved of immense value, and too much honor cannot be paid to the Prince and his collaborators for their devotion to science—a devotion which so far has brought them nothing but empty admiration and eulogies.

SCIENCE NOTES.

Some interesting facts concerning the mineral adulteration of textiles in every-day utility have been published by the Lancet, of London. According to this authority, whereas one hundred years ago the rustling of a lady's silk dress was attributable to the high quality of the silk, it now rustles owing to the impregnation of 36 per cent of salts of tin. Epsom salts, which have hitherto been mostly employed for medicinal purposes, are widely adopted for giving weight to flannel. Similarly, the old-fashioned pure linen used for table cloths is now largely substituted by cotton filled with china clay, starch, and size, while our linen collars are also founded upon base materials with simply a linen facing.

The process of slow distillation of metals readily fusible in a perfect vacuum, elaborated especially by Herr Karlbohm, has for some years led to results so favorable that it was desirable to see these processes extended to metals less fusible. Vessels of quartz are now coming into more general use with the result that much progress has been made in their manufacture as described by Herr Krafft in the Chemische Berichte. When the quartz reservoirs are not too thin, they may be raised to the temperature of 2,552 deg. F., while sustaining a perfect vacuum, without fear that they will be crushed by the effect of atmospheric pressure. At this temperature he has obtained the rapid distillation of a series of metals, among which are zinc, cadmium, silicium, tellurium, antimony, lead, bismuth, and silver. Copper and gold also distill at the maximum temperature of the experiments, but more slowly; their rapid distillation would require a higher temperature. The experiments have been confined to the laboratory, but the results have been so decided and encouraging that their application to the industrial rectification of metals is expected.

A series of interesting experiments to investigate by means of kites the relationship between the circulation of the upper and the lower strata of the atmosphere, in order to know what winds to expect, are to be carried out by the British Meteorological Society, which has devoted a portion of the government appropriation to this work. An experimental station is to be established in England, and instruments provided for kite ascents and other methods of investigations. The researches are to be international in character, for on certain days kites will be sent up simultaneously in England, France, Germany, and Russia. Mr. W. H. Dines, F.R.S., who is the leading authority upon this subject in England, will superintend the experiments, and he will be assisted by Col. Capper of the military balloon section at Aldershot, and Capt. Simpson of the steamship "Moravian," during his passages between Plymouth and Australia. The vessel will be provided with suitable kites, wire, winch, and the ingenious meteorograph, the invention of Mr. W. H. Dines, who has carried out important work in this branch of meteorological investigation on a government vessel off the west coast of Scotland. In these researches a string of kites was used, the largest of which was 12 feet high, with an area of 156 feet, and a weight of 20 pounds. The kites were flown on steel wire hawsers attached to a winch, wound by steam. A height of 10,000 feet was reached and recorded. The greatest danger attending these investigations is the liability of the steel wire being fused by lightning during thunderstorms.