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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.

WHAT WE INHERIT WITH THE PANAMA CANAL.

With American control of the Panama canal opening the second chapter in the story of the great isthmian waterway, we inherit a graveyard of many wrecked hopes and lives, with their monuments strewn from the Atlantic to the Pacific in the shape of decaying relics of an earlier engineering period. There is no richer digging in the ruins of an ancient Rome or Pompeii than along the deserted route of the canal. For upward of a quarter of a century some $20,000,000 worth of decaying machinery, buildings, and engineering implements have been buried in the moist soil. In nothing was the early French company more extravagant than in purchasing supplies for the isthmus. These included nearly everything that man could think of, and the shipments of the goods to the isthmus kept employed a small fleet of large and small ships. Every steamer that touched the isthmus in those palmy days of canal digging unloaded stacks of supplies for the engineers and their subordinates.

There was machinery by the scores and thousands of tons, large, small, and medium size; costly machinery and antiquated types of no real value at all; machinery that was to be used, and machinery intended for waste; machinery that was as much out of place in that far-away corner of the earth as steam radiators in the Desert of Sahara. Why this endless amount of machinery was shipped there, no one could explain; but it was all accepted, paid for, and then left to rot in the hot, moist climate. There were locomotives from Belgium and the United States, enormous steam hammers from England, great turning lathes from Germany, scoops, buckets, steel rails, and machine tools by the acre from all parts of the earth.

There were no storehouses sufficient to hold all these supplies. There are 2,431 buildings on the isthmus left by the old Panama company, many of which are hospital buildings and executive offices, but not all of these could store the machinery sent down to help dig the canal. What wonder, then, that machinery became ordinary articles of common use? Engineers and contractors stored what they could, and turned the rest out of doors to the tender mercy of a climate that quickly destroys steel and iron.

There were some who used the iron as foundations for their costly homes. Along the line of the canal, the silt of the soil is often as soft and slippery as quicksand. It filters through and into everything. It made the building of the canal a difficult engineering problem for the French, which they could never quite overcome. When you build substantial houses of stone or iron upon the running soil, there is no surety that the foundations will last. Some of the large houses built by the French officers of the company sank down into the silty soil, until to-day only the upper stories are visible. So, to make their homes more secure, some of them used the surplus machinery as foundations. There are houses on the isthmus that stand on $50,000 worth of machinery, which was never used for the purpose intended.

In many similar ways the surplus machinery was employed to keep it from standing idle. In parts of the isthmus it is found buried ten and fifteen feet below the surface soil. Unearth it, and you find it as soft and porous as cheese. It may be a huge iron anchor, a steel bucket, or a cast-iron scoop, that protrudes above the soil to attract the attention. With a penknife it can be cut and pared as easily as if it were an apple. In some mysterious way, the soil and climate has disintegrated the metal, so that its hardness has disappeared, and while retaining all of its outline and outward characteristics, it is no longer iron or steel. One wanders along the line of the canal to pick up odd pieces of relics, only to find them crumbling under the touch.

Not all the machinery, however, has been cast aside to sink into the loose soil of the canal. At Colon and Emperador it is scattered over miles of land that has been set aside for this purpose. Here, indeed, is the graveyard of France's past ambitions. One stumbles upon the monuments of a past which will forever live in the memory of those in any way associated with the Isthmus of Panama or the canal. Millions upon millions of useless, rotting, neglected property stands exposed to the disintegrating influences of the climate, sadly out of date now and fit only for the junk pile, but teeming with memories and possibilities of the glorious past.

There are miles upon miles of steel rails piled six feet high, sinking slowly into the soft soil, and rusting in the moist atmosphere. Rows upon rows of car wheels are apparent on every side, wheels which represent huge expenditures, but which were apparently simply dumped there and never used. Iron and steel buckets and scoops form an army of silent witnesses to man's folly and wasteful extravagance. Machine shops, filled with huge steam hammers and giant turning lathes for repairing the machinery used in excavating, are falling apart by their own weight. A dozen rows of locomotives—small in size and weight, and scarcely adapted to the work required of them—stand half sheltered under sheds that are themselves hardly able to stand up under their aged and weakened rafters. Rust and decay are apparent on these locomotives, as well as upon all other articles of use, and the hand of neglect appears stretched over the whole length and breadth of the isthmus.

When the trade winds die out, and the hot, sultry air of the isthmus ceases to move, a white mist will sometimes rise out of the swelling ocean, and hover like a fog over land and sea. This white mist is the precursor of fever and sickness, and those of the isthmus who know remain within doors, unwilling to meet the ghost of the ocean half way.

In the early days of the canal history, the white mist that rose from the disturbed soil of the isthmus was far more disastrous in its killing effects than the mist of the ocean. It rose from the soil like incense from a brazier. It carried with it from its underground prison all the poison of putrefaction, and wherever it inclosed its victims, there fever and death followed. The soil is moist and damp, and when disturbed in that hot climate, it releases a dense white mist. For generations past luxuriant vegetation has been decaying in the soil, and when the surface is scratched, strange, unhealthy gases and poisonous vapors rush upward to spread around. Tier upon tier of annual crops of rich vegetation are packed down solid over the surface of the soil. In this hotbed of feverish decomposition, the process of fermentation and disintegration is ever in active operation. Fortunately, nature holds most of the deadly exhalations in close prison walls; but when man comes along to disturb the even balance, trouble begins. In the hot, damp air of the isthmus, the poisonous exhalations released from the soil mingle with the mist, and the "white ghost of the canal" is accounted for. When the Frenchmen excavated for the canal, the mist hovered over their camps and homes during the greater part of the year. It entered nearly every home to claim its victims. Men died like beasts in the field. They were stricken at their work, in their tents, in their beds, and even at the gaming or wine and card table. It was all one with the monster; it knew neither rank nor condition, wealth nor poverty. Only the native knew enough to avoid it, and to keep away from the fever camps of the company.

COST OF ELECTRIC HEATING.

Efficiency in electric heaters is perfect at one hundred per cent. In other words, all of the energy absorbed as electric current reappears as heat.

This is true of no other type of heater. An ordinary coal or wood stove gives off only one-quarter to one-half of the heat energy of its fuel. Radiators in the best steam and hot-water plants yield about seventy per cent of the latent heat of the coal burned in their boiler furnaces.

The remainder of the fuel energy escapes from the boilers in the latent heat of the unburned gases, and as sensible heat of the products of combustion.

Gas heaters, like stoves and furnaces that burn wood and coal, are subject to losses of heat because of imperfect combustion and also because of the high temperature of the escaping products. Probably fifty per cent is as high an efficiency as can ordinarily be expected with gas stoves.

All of the foregoing applies to those cases where electric heaters, wood, coal, or gas stoves, or steam or hot-water plants are employed to warm the air in buildings. Where either coal or gas stoves or furnaces are used for cooking or industrial operations the efficiency between the fuel and the work is in almost all cases an unknown quantity. Thus, who can say how much of the contained heat energy of fuel enters a mass of bread baked by it; or what percentage of the heating power of gas or coal is absorbed by a smoothing iron? About all that can be done in such cases is to determine how much fuel must be expended per pound of bread baked or for each smoothing iron per hour when maintained at a given temperature.

In almost every instance where combustion is employed to develop the heat for industrial operations there is a great and necessary loss between the fire and the object to be heated. This is due in part to the fact that the fire and its containing stove or furnace is large and the object to be heated is small, so that while heat is escaping by radiation and conduction in every direction, it is utilized in only one.

Where electric heaters are applied to industrial operations, most of these losses just named are avoided, because the energy is transformed at or within the object to be heated. Thus an electric stew-pan has the heat developed in coils attached to its bottom, and such coils are actually within the electric smoothing iron. This feature gives electric heating a great advantage in point of economy for most industrial operations. So great is this advantage, that in most industrial applications of heat it is probably necessary to burn several times as much fuel if the heat is transmitted directly to the objects on which it is to act as when it is developed there by electric current. It seems certain, therefore, that electric supply systems can well afford to make rates for current that will insure its application to cooking on a large scale and to special heating in manufacturing plants, especially where current for these purposes can be delivered at times during each twenty-four hours when the power and lighting loads are much below their maximum. Users of heat for special purposes find it to their advantage to pay something more than their former expense for fuel in order to procure electric current to do the same work, because the labor and risk of local fires are thus saved. Applications of electric heat along industrial lines are now rapidly multiplying and its ultimate triumph in that field seems assured.

For the general heating of the air in buildings the prospects are not so encouraging. Even here it seems, however, that there are many cases where electric heaters may displace those that burn coal or gas. The range of the problem may be gathered from the fuel cost of heat from gas or coal. Even in years when there is no strike among the miners $7 per ton is not an unusual price for the first grades of anthracite coal. At this price per ton of 2,000 pounds the cost per pound is 0.35 cent. Each pound of such coal yields on perfect combustion about 12,000 heat units, but in house fires generally the heating effect actually obtained is probably no more than 30 per cent of this, or say about 3,600 heat units per pound. One kilowatt hour of electrical energy is the equivalent of 3,438 heat units, and many electric systems are now able to deliver this amount of energy to consumers on a consumption of three pounds of soft coal costing 0.33 cent when this coal can be had at $2.50 per ton of 2,240 pounds in carload or shipload lots. Under the several assumptions just made it appears that the cost of fuel in the electrical supply system per kilowatt hour delivered is just about equal to the cost of anthracite coal to develop an equivalent amount of heat on the premises of a consumer. The question then is whether consumers will pay enough above the amount which either they or the electric supply company must expend for fuel, to induce that company to operate its plant for heating when the power and lighting loads are small. Considering the saving of labor to consumers, the fact that electric heat can be applied instantly when wanted, and that no combustion or gases accompany its production, it seems that this question must have an affirmative answer in many cases.

Illuminating gas is finding extending application in the warming of buildings, but in safety and in its effect on confined air it is much inferior to electrical energy for this purpose. It is also sound to assert that during many hours in each twenty-four electrical energy can be profitably sold for heating at rates that make it at least as cheap as illuminating gas at the lowest common prices.

Comparatively few cities in the United States have a rate as low as $1 per 1,000 cubic feet for illuminating gas. At this rate the entire heating power of the gas obtained for one dollar is about 650,000 heat units, but owing to imperfect combustion and to the high temperature of the burned gases, hardly more than 325,000 units of heat are made available for general warming with ordinary gas stoves, for each thousand feet of gas consumed. This gives 3,250 heat units for one cent. At the rate of one cent per kilowatt hour the electric heat available for that sum is 3,438 units, or a little more than that obtainable from gas at an equal cost. As low a rate as one cent per kilowatt hour is already made in many instances to large users of electric motive power during the regular working hours of each day. For a load like electric heating, that extends over the entire twenty-four hours of each day, an even lower rate might be made with profit to the supply system.

When the cheapness of electric heat is better understood by the public, and the desirability of all-day loads is more fully appreciated by central station managers, a great increase in the application of electric current to heating for industrial and general purposes is sure to follow.—Alton D. Adams.

STUDY OF FOREST CONDITIONS.

A study of forestry seems to be especially esteemed in countries where there are no longer forests to study. Realizing how vital to the welfare of a nation is the preservation of its forests, the United States is making an endeavor to study and improve the forests of this country while there is yet time to preserve them. In furtherance of this work the United States Geological Survey has just published a paper which bears the title "Forest Conditions in the San Francisco Mountains Forest Reserve, Arizona."

The San Francisco Mountains Forest Reserve comprises portions of the broad summit and slopes of an elevated tract of land in north-central Arizona, which includes the southern part of the Colorado Plateau. The northern part of the area is dotted by several hundred volcanic cones and the southern part is gashed by numerous deep canyons. The altitude of the region ranges from 3,500 feet at Oak Creek in its southwestern portion, to 12,794 feet at the summit of San Francisco Peak.

Among the coniferous trees in the reserve the yellow pine constitutes over 99 per cent of the total forest. The aspen takes first rank among the broad-leaved species, but has a close competitor in the oak. The chief lumber tree at present is the yellow pine, which is extensively cut and furnishes all of the mill timber sawed, used in, and exported from the region. Its average total height is 85 feet, with about 10 feet of clear trunk. The diameter averages 18 inches, which corresponds to an age of 180 years. In the 812,500 acres of forest area examined 2,743,558,000 feet B. M. of standing timber were found, which gives an average of only 3,377 feet B. M. per acre. It is evident that the yellow pine stands, even where entirely untouched by the ax, do not carry an average crop of more than 40 per cent of the timber they are capable of producing. This condition is chiefly attributable to the numerous fires which have swept over the region within the last two hundred years, destroying seedling and sapling growth.

The chief agencies through which the forests in the reserve suffer destruction are cutting, grazing, and fire. Logging operations have been carried on in most of the central forested areas that are tributary to railroads. The forest has been culled or cut from 148,845 acres. The timber cut on these tracts has been converted into tie, stull or round mining timber, and saw logs.

Grazing, especially sheep herding, is ruinous to the seedling growth of a young forest. Sheep are especially fond of the young aspen, which springs up as the first restockage on the non-forested park lands at the base and on the slopes of the San Francisco Mountains. It was found that the destruction of seedlings on any particular tract of land ranged from 50 per cent to total after a single passage over such ground by 2,000 head of sheep.

Fires have been of frequent occurrence in all portions of the reserve. The badly-burned areas, on which the destruction has been 60 per cent or more, aggregate 6,790 acres. The origin of fires in recent years may, in part, be ascribed to the carelessness of sheep herders, in part to sparks from engines on the Atchison, Topeka & Santa Fe Railroad, but by far the larger number of fires are due to lightning, and this cause has, of course, always operated. Sections exist on which 50 per cent of the mature yellow pine has been either wholly or in part killed by lightning strokes.

Among other interesting questions considered in this paper are the low reproductive ratio of the yellow pine, the influence of the forest on run-off, the grazing value of the reserve, and the effects of sheep herding on the forest floor. The bulk of the paper is devoted to detailed descriptions of the areas, by range and township, that make up the reserve.

LONG-DISTANCE NON-STOP RAILROAD RUNS IN GREAT BRITAIN—A NEW WORLD'S RECORD.

A new record in railroad traveling has been established by the Great Western Railroad, of Great Britain. On July 1 a regular non-stop daily train service was established between the London terminus at Paddington and Plymouth. The distance is 246 miles, and the "Cornishman Limited Express" is scheduled to cover the journey in each direction in 265 minutes without a single stop. This supplies an average speed of 55.69 miles for the journey. This, therefore, constitutes the longest non-stop railroad run in the world.

Ever since the year 1896 this railroad has retained such a non-stop record, for in that year the railroad company initiated a through non-stop train from London to Exeter, 194 miles, covered in 3 hours 45 minutes. During the subsequent years, however, this run has been increased to 3 hours 30 minutes, equal to an average speed of 51.7 miles per hour. In the recently inaugurated run, however, the time between these two points has been still further reduced by five minutes, increasing thereby the average speed to 56.7 miles per hour. Hitherto this railroad has not been able to make the journey a non-stop one beyond Exeter, owing to the absence of the water trough between the tracks from which to replenish the engine's water supply. Now, however, a trough has been laid down at Starcross, between Exeter and Plymouth. Furthermore, the coal capacity of the engine has been considerably increased, and larger lubricating boxes have been supplied, so that the oil boxes can contain a sufficient supply for the entire journey.

Meritorious though this run of 246 miles in 265 minutes is, yet, if the necessity arises, the speed can be considerably accelerated. This fact was demonstrated on May 9 last, with the mail-train run in connection with the North German Lloyd liner Kronprinz Wilhelm. On this occasion the train covered the distance of 246¾ miles from the dock at Plymouth to Paddington in the remarkably short time of 3 hours 46 minutes. The run, however, was not a non-stop, as a mail van was detached and engines changed at Bristol, necessitating a halt of 3 minutes 43 seconds, which stop, however, was included in the time of the run. The average speed on this occasion was 65.49 miles per hour for the whole journey, and the last 36 miles of the run to Paddington was covered at the rate of 79.17 miles per hour. On the occasion of the trial run of the "Cornishman Limited Express," a new record was made between London and Bath, the 107 miles being completed in 102 minutes.

The road, although not so level as that between Camden and Atlantic City, is yet comparatively easy, but after leaving Exeter the road becomes more difficult. Especially so is the last 52 miles into Plymouth, the track abounding in stiff gradients of 1 in 40, with numerous sharp curves, which militate considerably against fast traveling.

There is strenuous friendly rivalry at present existing among the various English railroad companies to establish non-stop records. The London and North-Western Railroad is contemplating the establishment of a through non-stop service between London and Carlisle, a distance of 299¼ miles. They have already made such a run with a "special," which covered the journey in 5 hours 43 minutes, an average speed of 51 miles per hour. With their latest type of engines, however, this railroad company could considerably increase this speed if desired. On the occasion of the Postal Congress at Glasgow last year, the train containing the delegates, and representing a weight of 450 tons, was hauled over the 401½ miles between the two cities, both on the outward and return journeys, without a stop in 6 hours and 6 hours 5 minutes respectively, at average speeds of 66.9 miles and 66 miles per hour.

Already the boat trains running from Liverpool to London in connection with the incoming American mails, three or four times a week, cover the 192 miles in 3 hours 45 minutes, an average speed of 51 miles per hour. Other notable long-distance non-stop runs on this system include Wigan to Willesden, 188½ miles, in 3 hours 41 minutes, average speed 51.1 miles per hour; London to Stockport, 183 miles, in 3 hours 18 minutes, speed 55.4 miles per hour; London to Chester, 179 miles, in 3 hours 33 minutes, speed 50.4 miles per hour.

The Midland Railroad also have inaugurated several noteworthy long non-stop runs. The record is that recently instituted between London and Leeds, 198 miles, in 3 hours 45 minutes; speed, 52.8 miles per hour.

The Great Northern Railroad, which for many years has been considered the crack fast railroad of Great Britain, but which has since lost its reputation in this respect, is also completing arrangements whereby it will be able to regain its lost prestige. Several of the through northern expresses cover the journey every day between Grantham and London, 105 miles, without a stop. Their present longest non-stop run is between Wakefield and London, 175¾ miles, in 3 hours 10 minutes, an average speed of 55.5 miles per hour. Owing to the institution by the Midland Railroad of a through express between London and Leeds, the Great Northern, which also serves the latter town, is instituting a similar service, the 185½ miles to be covered in 195 minutes—an average speed of 57.07 miles per hour.

The Great Northern Railroad also proposes considerable accelerations in connection with the East Coast expresses. For this purpose mammoth powerful engines have been constructed. These are designed by the railroad engineer, are of the compound "Atlantic" class, and represent the limit of the dimensions of a locomotive of the normal type in Great Britain. They have been specially designed to work the East Coast route express trains at a speed varying from 55 to 60 miles per hour, with loads of from 380 to 400 tons behind the tender.

The special feature of this type of engine is the length and circumference of the boiler. The inside diameter of the boiler is 5 feet 6 inches, and the length of the tubes, representing the distance between the smoke-box and the fire-box, 16 feet 3 inches. The heating surface furnished by the tubes aggregates 2,800 square feet, while that of the fire-box supplies about another 200 square feet. The grate area is 32 square feet. The working steam pressure is about 185 pounds per square inch. The two outside cylinders measure 18 inches diameter by 24-inch stroke, and the diameter of the four driving coupled wheels is 6 feet 8 inches. The length of the engine and tender is 58 feet over all, and their combined weight in working order is 110 tons.

SCIENCE NOTES.

A new local anæsthetic of the cocaine order has been discovered. It is called "eucaine," and the advantage of the drug will enable the carrying out of those operations otherwise impossible with chloroform, owing to heart weakness of the patient. It will also enable the surgeon to take more time over his work. Although scarcely adaptable for amputations, it will be useful for treatment of the thyroid glands. The eucaine is injected by means of a hypodermic needle under the skin at the place where the incision is to be made. After a few moments the skin may be cut without the patient feeling anything. As different and independent parts are exposed, the drug is dropped at intervals of a few minutes. A highly successful operation with this anæsthetic was recently carried out in a London hospital, the operation lasting one and a half hours.

The use of an automobile to form a portable station for astronomical work was brought out in a paper recently read before the Académie des Sciences. The work was carried on by Messrs. E. Tronchet and Henri Chrétien, accompanied by the well-known chauffeur Maurice Farman. The report relates to the study of the Leonids in 1903 and the determination of their altitudes by the method of simultaneous observations. The systematic observation of the Leonids was carried on during that year at the Observatory of Chevreuse, with a view of determining the relative position of these bodies with greater precision. To carry this out, the observations were made simultaneously at two different stations situated about 18 miles apart. This distance is large enough so as to make the errors of observation relatively small, and, on the other hand, it is sufficiently short to allow of a sure identification of the meteors which are observed by the double method. The first station was located at the Chevreuse Observatory, whose co-ordinates are: West longitude, 0 deg. 19m. 6s.; N. latitude, 48 deg. 42m. 33s.; altitude, 163 meters. The second station was placed in the Beauce region at Authon la Plaine (co-ordinates 0 deg. 23m. 1s.; 48 deg. 27m. 16s.; altitude, 145 meters). The rectangular distance between the stations measures 28.7 kilometers, and the azimuth of the first, relative to the second, is +10 degrees. As at that time of the year the weather was not generally favorable, in order to make the work easier to carry out the second station was formed by an automobile equipped with the necessary apparatus, which could be driven to the observation point in less than an hour in case of favorable weather. This method of arriving at the spot was all the more appreciated as the radiating point of the Leonids did not rise until very late and the observation had to be made during the latter half of the night. The observations were made on the nights of the 13-14th and 14-15th of November from 1 to 5 o'clock, and were registered on a special chart which was furnished by the Meteor Commission of the Astronomical Society. Chronometers (checked up before and after) gave the exact time. The number of meteors registered was 83 and they appeared to come from four principal radiants. The co-ordinates of these sources are as follows:

A. R.	D.
137 deg.	+23
75	45
110	32
67	17

The meteors which were observed simultaneously at the two stations were identified by the coincidence of the readings. Out of twenty-two such coincidences, twelve presented sufficient guarantees of exactitude to allow of calculating the altitudes. The report gives the various data for the twelve meteors, together with the altitudes. The mean height of apparition is 103.6 kilometers; that of the disappearance is 75.8 kilometers. The mean length of trajectory is 35.2 kilometers.

Mr. Lyman B. Brainerd, the treasurer of the Hartford Steam Boiler Inspection and Insurance Company, has been elected to the presidency of that corporation to succeed the late J. M. Allen. Mr. Brainerd has had a large experience in the management of corporations, and he will retain his office as treasurer.