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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.


## RATIFICATION OF THE PANAMA CANAL TREATY.

The decision of the Senate, by an almost unanimous vote, in favor of the ratification of the Panama Canal treaty with Colombia, marks the close of one of the most momentous and long-drawn-out controversies in the history of Congress. Moreover, to those who have followed closely the political history of the Panama-Nicaragua Canal struggle, this happy consummation will be regarded as a distinct triumph of common sense and sober second thought over much misinformation, some measure of misrepresentation, and a large measure of general ignorance upon what was first and last a highly technical subject.

The Scientific American has double cause to be pleased at the outcome. We are gratified to realize that by this decision the country's energies have been diverted from a doubtful undertaking at Nicaragua to a perfectly practicable one at Panama. We find further cause for gratification in the fact that at a time when there was a woful lack of knowledge as to the actual merits of the two routes, the Scientific American was the first journal to place these facts clearly and succinctly before the public in a popular and perfectly understandable form, thereby initiating that campaign of public enlightenment which was all that was needed to insure the final adoption of the Panama route as being from every point of view the most feasible.

In the winter of 1898-99, when we undertook to investigate impartially the merits of the two routes and place the full engineering data in comparative form before the public, the prospect of the adoption by the nation of the Panama route appeared to be practically hopeless, and this for more than one reason. In the first place, there was in favor of Nicaragua that most potent of all arguments, the so-called patriotic one; for Nicaragua had been associated from the very first in the minds of the American people with American engineers and American capital. Indeed, it was looked upon as the distinctively American scheme as opposed to Panama, which represented in the popular eye a purely European and, therefore, in some sense an antagonistic enterprise. And Panama, moreover, was laboring under the odium of the failure and scandals arising out of the gross mismanagement of the first Panama Canal Company; while scarcely less potent than this was the active propaganda which had been carried on by the Nicaragua interests through the press against the Panama Canal scheme as such; especially as concerns its physical and strictly engineering aspects. The floods of the Chagres River and the sliding in of the great Culebra cut had been insisted upon in many a lengthy magazine article by well-known engineers, as rendering the construction of a successful canal at Panama an absolute physical impossibility. All the manifest advantages of that route (now so well understood and appreciated) were never so much as hinted at; while the general public was left with the impression that the failure of the first Panama Company was due entirely to the physical obstacles to a canal at this point, and not, as is actually the case, to the gross mismanagement and willful misappropriation of funds which marked the first attempt at construction. On the other hand, the flood of literature, laudatory of Nicaragua, which had been poured out upon the country, expatiated at length upon the supposed advantages of the rival scheme, such as the existence of the Nicaragua Lake, the shortness of the cut to the main divide, etc., and passed over, almost without reference, the glaring weaknesses in the Nicaragua plans, such as the construction of the huge rock-fill dam across the San Juan River, and the building of miles of costly and unstable retaining embankments along the proposed high-level route.

To the late Gen. Ludlow is due primarily the credit for stemming this tide of misinformation by his most able and impartial report, made after his commission returned from an investigation of the Nicaragua route, a report which was sustained first by the Walker commission, and finally by the President's commission.

It is true that the first report of the President's commission was in favor of the construction of the Nicaragua route, but the commission carefully stated that this choice was due to the exorbitant price asked by the Panama Company for their properties on the route of the canal. As soon as this company agreed to accept for these properties the price of $40,000,000, which was their value as assessed in the report, the commission unanimously reported in favor of the Panama route. Briefly summed up, the advantages that determined this choice as stated by the commission were: That the Panama route would be 134.6 miles shorter; that it had fewer locks and less curvature; that it would take a vessel 21 hours less time to traverse the canal; and that the annual cost of maintenance and operation would be $1,300,000 less. With the ratification of the treaty, the last hindrance to the completion of this magnificent work is removed. Of the enormous value, commercial and political and military, of the canal to this country, it is unnecessary to speak; and we have not a doubt that the future historian of the rise and growth of the great republic of the western world will bear out the statement that few decisions of more significant and wide-reaching effect have been taken than this vote of Congress to cut a deep-sea canal route through the Isthmus.

## A SIGN OF THE TIMES.

There are many proofs of the flourishing condition of the shipbuilding trade in this country, and none of them is stronger than the fact that it is exceedingly difficult to secure a sufficient number of really skilled workmen to insure the carrying out of orders within contract time. Only recently we noted in these columns that in a report of the Chief Constructor to the Secretary of the Navy, delay in the construction of vessels was attributed to the scarcity not only of skilled workmen, but also of persons equipped with competent technical knowledge in the designing, drafting, and oversight necessary in the construction of ships. This scarcity, by the way, is noticeable not merely in naval work, but in general marine work, even including that specialized branch of it known as yacht designing.

Now in these days, when so many professions are over-supplied, we think it is timely to direct attention to the present scarcity in naval architecture and suggest that, in view of the great expansion which will take place in the future of our shipbuilding interest, both merchant and naval, it would be well for any young man who is thinking of going into draftsmanship, whether merely as a handicraft or as a stepping-stone to the full mastery of some particular profession, to remember there is no more promising field, just now, than that of naval architecture. That ship draftsmen are particularly scarce is shown by the fact that the Chief Constructor of the Navy has only recently sent out a memorandum to the effect that there is an immediate demand for all-round ship draftsmen, not merely at headquarters, but at several navy yards throughout the country. The rapid growth of our commerce renders it likely that the present activity in naval construction will continue, and the field thus opened is a promising one.

## RISE OF WATER POWER IN ELECTRICAL SUPPLY.

BY ALTON D. ADAMS

Water power is destined to operate the greater part of electrical supply and street railways in North America. A large beginning in this direction has already been made. Electrical loads are being transferred to water power faster than they are created and steam plants reduced to occasional use. Meantime development of the vast resources of water power on this continent is only in its initial stage.

It is hardly half a decade since the advantage of water power in systems of electrical supply was still a mooted question. To-day the rapid introduction of water power is the most notable change that is taking place in electrical systems. The connecting link between many water powers and their wider application in electric lighting and traction is long distance transmission at high voltage. It now seems a far cry back to the transmission of energy over a distance of thirty miles at 10,000 volts in Southern California, during 1892. At that time the distance and the voltage both seemed to many engineers impracticable. Ten years later as many as ninety transmission systems in North America employ a voltage equal to or exceeding that of the pioneer plant. The water-power plants of these systems are equipped with generators of more than 276,000 horse power capacity. Of this generator capacity the United States contains approximately 222,000, Canada 33,000, and Mexico 21,000 horse power. These figures are necessarily incomplete and below the actual facts because of the rapidity with which additions are being made.

Besides the systems in which energy from water power is transmitted at pressures not less than 10,000 volts there are great numbers that are so near to their water powers that this voltage is not necessary.

It is not possible to give comprehensive figures for either the number or capacity of these systems that transmit water power at pressures below 10,000 volts in North America, but this may be done for the electrical supply systems of a single State. These systems in Massachusetts to the number of eighteen, in the present year, have generating equipments at water power stations with a total of more than 10,000 horse power capacity, all sending out energy at less than 10,000 volts. Compared with the 10,000 horse power of 1902, the electric lighting stations of Massachusetts contained water-driven equipment of only 685 horse power in 1891. No doubt figures from other States would show a similar growth in the number and capacity of these transmissions from water power at moderate voltages.

Turning again to the transmissions at 10,000 or more volts, they may be found scattered through twenty States, besides Canada and Mexico. The greatest single water power system is that at Niagara with a capacity of 50,000 horse power in actual use and an addition of 30,000 horse power partly completed. The next largest plant is that at Colgate, Cal., of 15,000 horse power; Chamblay, Quebec, follows with a plant of nearly 11,000 horse power, and then come the water-power systems at Hamilton, Ontario, and Snoqualmie Falls, Washington, with 8,000 horse power each, in capacity of electric generators. Not less than eighteen transmission systems have water-power equipments of 4,000 or more horse power capacity, and as many as fifty-five systems drive generators of not less than 1,300 horse power with water. Among the States, New York leads with a capacity of nearly 100,000 horse power in its electrical transmissions from water power, but one-half of this is at the Niagara plant alone. California is second in point of capacity, with about one-half that of New York in its numerous, long transmissions. Utah, Montana, and Colorado follow with not less than 15,000, 12,000, and 8,000 horse power capacity respectively in their systems of transmission at above 10,000 volts from water powers.

California leads in the use of high voltage, having at least one system that operates at 60,000 volts. Montana has a transmission at 50,000 volts, and Utah and Michigan contain 40,000-volt systems. In Canada at least four water-power plants operate at 20,000 or more volts on their lines. Minnesota has one 30,000-volt transmission and Alabama another. At least two transmissions in New York are carried out at 20,000 or more volts. More than forty-five systems now employ 15,000 or more volts on their transmission lines.

California again leads in the distances over which electrical transmissions are carried out. That State contains one system with 140 miles, and another with 145 miles of line between the water-power station and the point where the greater part of the energy is used. In Montana there is an electrical transmission seventy miles long. Utah has a transmission of 55 miles, and Washington two of 45 miles each. In Michigan there is a transmission line 46 miles long from a water-power plant, and Minnesota has a similar line of 28 miles. Electrical energy is transmitted 30 miles from water power in Alabama, 27 miles in New York, 20 miles in Maine, 25 miles in Colorado, and 37 miles in Ontario.

The transmission systems of 10,000 or more volts pressure show a range from 25 to 133 in the numbers of cycles per second of the alternating currents employed. The lower of these figures is the standard at Niagara, but probably in only one of the other systems. One plant in Canada and one in California employ 133-cycle current. In a few other transmission systems may be found energy at 30, 38, 50, and 66 cycles per second. The standard for most of these water-power transmissions, however, is 60 cycles per second. This general preference for the 60-cycle current is due to the fact that it is suited to the operation of both arc and incandescent lamps as well as to that of induction motors. Most of the plants operating at less than 60 cycles per second deviate the greater part of their energy to the operation of motors.

Of the 90 transmissions at not less than 10,000 volts, only one is carried out with single-phase current. Three-phase lines are the most numerous, comprising more than fifty out of the total. About 39 of these high pressure systems operate two-phase. Induction motors, arc and incandescent lamps give equally good results on systems of either two- or three-phase, but the three-phase currents have a small advantage as to the transmission lines. Great extensions are to be expected with two- and three-phase currents between 40 and 60 cycles per second.