The Sun's Harvest at Last

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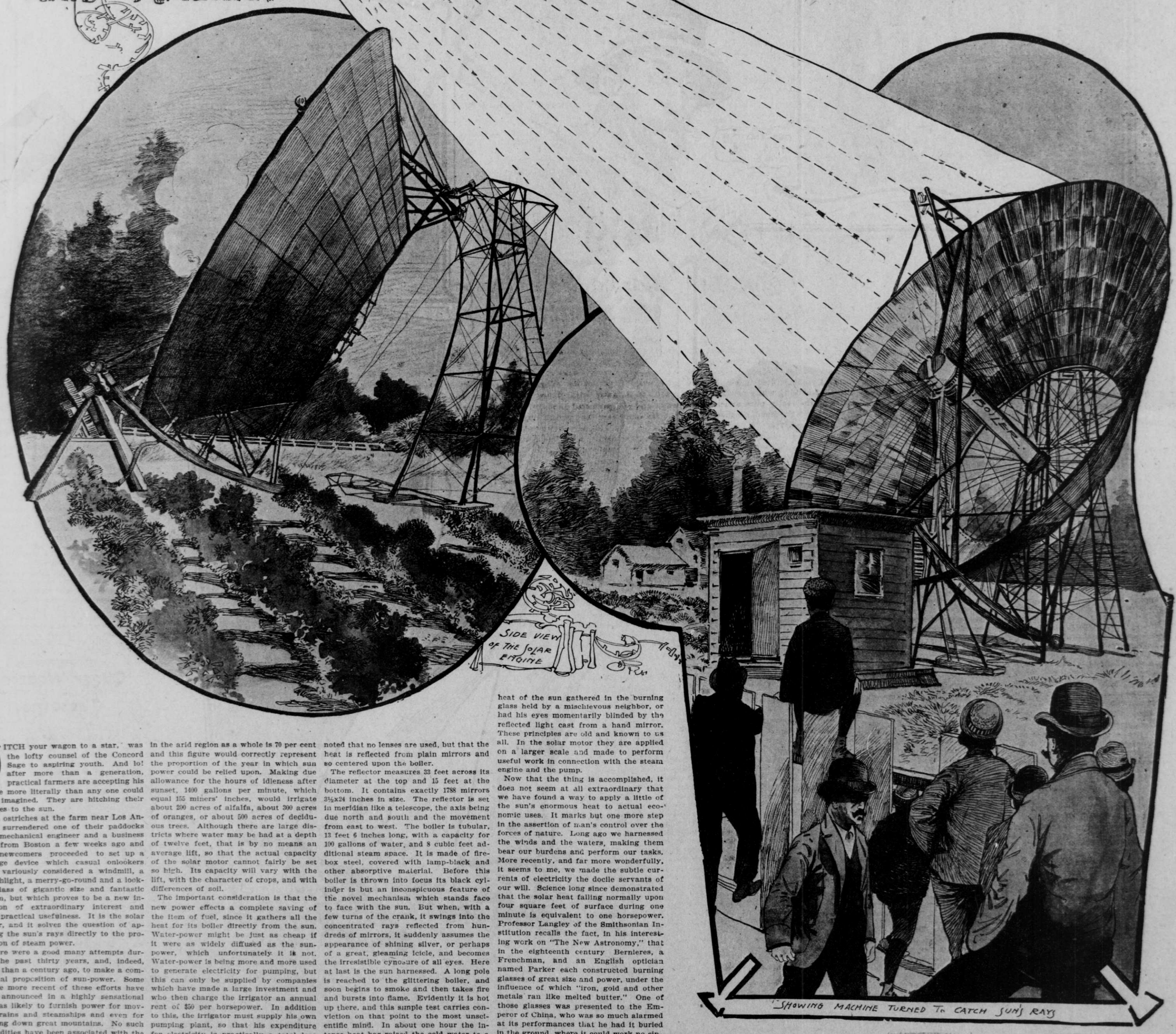

HITCH your wagon to a star," was the lofty counsel of the Concord Sage to aspiring youth. And lo! after more than a generation, practical farmers are accepting his advice more literally than any one could have imagined. They are hitching their engines to the sun.

The ostriches at the farm near Los Angeles surrendered one of their paddocks to a mechanical engineer and a business man from Boston a few weeks ago and the newcomers proceeded to set up a strange device which casual onlookers have variously considered a windmill, a searchlight, a merry-go-round and a looking-glass of gigantic size and fantastic design, but which proves to be a new invention of extraordinary interest and wide practical usefulness. It is the solar motor, and it solves the question of applying the sun's rays directly to the production of steam power.

There were a good many attempts during the past thirty years, and, indeed, more than a century ago, to make a commercial propcsition of sun-power. Some of the more recent of these efforts have been announced in a highly sensational way as likely to furnish power for moving trains and steamships and even for leveling down great mountains. No such absurdities have been associated with the solar motor which is now attracting the attention of scientific men and popular crowds at South Pasadena.

Indeed, nothing has been claimed for it. The device speaks for itself in the modest but impressive language of actual daily performance.

It drives a ten-horsepower engine from an hour and a half after sunrise to within half an hour of sunset. Its performance has gradually increased with each day's trial and the perfecting of details and there is no reason to suppose that its maximum has been reached, nor that it will be with the present model. At this writing its best record is the raising of 1400 gallons per minute at a lift of twelve feet. The average percentage of sunshine in the arid region as a whole is 70 per cent and this figure would correctly represent the proportion of the year in which sun power could be relied upon. Making due allowance for the hours of idleness after sunset, 1400 gallons per minute, which equal 155 miners' inches, would irrigate about 200 acres of alfalfa, about 300 acres of oranges, or about 500 acres of deciduous trees. Although there are large districts where water may be had at a depth of twelve feet, that is by no means an average lift, so that the actual capacity of the solar motor cannot fairly be set so high. Its capacity will vary with the lift, with the character of crops, and with differences of soil.

The important consideration is that the new power effects a complete saving of the item of fuel, since it gathers all the heat for its boiler directly from the sun. Water-power might be just as cheap if it were as widely diffused as the sun-power, which unfortunately it is not. Water-power is being more and more used to generate electricity for pumping, but this can only be supplied by companies which have made a large investment and who then charge the irrigator an annual rent of $50 per horsepower. In addition to this, the irrigator must supply his own pumping plant, so that his expenditure for electricity is practically a total loss as compared with sunpower. The natural comparison of the solar motor is with the windmill, since both are automatic, being operated by the elements.

"How does it run and how does it look?" will naturally be asked. It looks not unlike a huge umbrella, although this illustration should not be construed to mean that the solar motor is a frail structure. On the contrary, it is large and substantial, weighing 8300 pounds. But in shape it much resembles an umbrella open and inverted, and is so disposed as to catch the sun's rays on the mirrors which line its inside surface and to reflect both light and heat with concentrated energy on a long, slim boiler, which is where the umbrella stick ought to be. It should be noted that no lenses are used, but that the heat is reflected from plain mirrors and so centered upon the boiler.

The reflector measures 33 feet across its diameter at the top and 15 feet at the bottom. It contains exactly 1788 mirrors 3½x24 inches in size. The reflector is set in meridian like a telescope, the axis being due north and south and the movement from east to west. The boiler is tubular, 13 feet 6 inches long, with a capacity for 100 gallons of water, and 8 cubic feet additional steam space. It is made of fire-box steel, covered with lamp-black and other absorptive material. Before this boiler is thrown into focus its black cylinder is but an inconspicuous feature of the novel mechanism which stands face to face with the sun. But when, with a few turns of the crank, it swings into the concentrated rays reflected from hundreds of mirrors, it suddenly assumes the appearance of shining silver, or perhaps of a great, gleaming icicle, and becomes the irresistible cynosure of all eyes. Here at last is the sun harnessed. A long pole is reached to the glittering boiler, and soon begins to smoke and then takes fire and bursts into flame. Evidently it is hot up there, and this simple test carries conviction on that point to the most unscientific mind. In about one hour the intense heat has raised the cold water to a high temperature, evaporated it into steam, and a pressure of 150 pounds is shown on the gauge in the engine room. For, be it understood, the solar motor is not a sun engine in the sense that it is operated without the intervention of steam power, as the water wheel is turned by the falling stream. The sun strikes the mirrors; the mirrors reflect the heat upon the boiler; the heat turns the water within the boiler into steam; the steam passes from the head of the boiler through a flexible metallic pipe into the engine cylinders, and from that point the process is the familiar operation of the compound engine and the centrifugal pump. There is nothing occult, nothing new. Every boy has felt the concentrated heat of the sun gathered in the burning glass held by a mischievous neighbor, or had his eyes momentarily blinded by the reflected light cast from a hand mirror. These principles are old and known to us all. In the solar motor they are applied on a larger scale and made to perform useful work in connection with the steam engine and the pump.

Now that the thing is accomplished, it does not seem at all extraordinary that we have found a way to apply a little of the sun's enormous heat to actual economic uses. It marks but one more step in the assertion of man's control over the forces of nature. Long ago we harnessed the winds and the waters, making them bear our burdens and perform our tasks. More recently, and far more wonderfully, it seems to me, we made the subtle currents of electricity the docile servants of our will. Science long since demonstrated that the solar heat falling normally upon four square feet of surface during one minute is equivalent to one horsepower. Professor Langley of the Smithsonian Institution recalls the fact, in his interesting work on "The New Astronomy," that in the eighteenth century Bernieres, a Frenchman, and an English optician named Parker each constructed burning glasses of great size and power, under the influence of which "iron, gold and other metals ran like melted butter." One of those glasses was presented to the Emperor of China, who was so much alarmed at its performances that he had it buried in the ground, where it could work no sinister miracle.

The later efforts of Mouchot and of Ericsson are well known. The former exhibited a sun engine which operated a printing press at the Paris Exposition of 1870, while the architect of the famous Monitor brought his device so near perfection that scientific men began to build serious hopes upon it in 1884. But none of these inventions were able to stand the test of application to actual commercial uses. They concentrated the rays of the sun. They made steam. They even drove engines. But when brought to the crucial test of practical, every-day uses—cheap manufacture, economical and continuous operation—they failed. And so it has been with many other less celebrated efforts.

While the present successful motor has been developed in the fullest light of existing scientific knowledge, the solution of the problem is a triumph of American genius, which has built a successful device on the ashes of past failures.

The most obvious advantage of the solar motor is the saving of fuel. It will be used over wide districts where the cost of fuel is prohibitive, and will even supersede all other power in the uses for which it is adapted in localities where fuel is most abundant, since it is plain that no fuel is cheaper than any fuel. The saving is effected not merely in the purchase price of coal or wood, oil or gasoline, but also in the item of handling these materials. The solar rays are not only furnished without cost, but by a convenient provision of nature are freely transported to the place of use, which is wherever the reflector may happen to be erected.

The usefulness of sun power will be by no means limited to irrigation, nor should it be inferred by the size of the present engine that ten horsepower bounds its possibilities. The new motor will be used for various industrial purposes, and probably quite largely in connection with mining. Plants of 100 horsepower, with several reflectors grouped about a central engine, are already feasible, and it is quite within reason to expect that with the improvements which will naturally be added as time goes on the present maximum will be much increased.

It is in its relation to irrigation, however, that the successful utilization of sun power will excite the widest public interest. Mining is an industry which flourishes in spite of all obstacles. There is no country so far nor climate so severe—there is no peril and no expense which can discourage mining, because the possible reward is so great and the hope of sudden wealth so alluring. It may be sad and deplorable, but it is none the less true, that a man will risk less for a home than for a fortune. There are certain heroic exceptions to the rule, but the fact remains that the conquest of the desert must be made easily if made at all. Here lies the chief significance of the new power, since its operations are necessarily limited, for the present at least, to the sunshine regions of the earth.

Half of our own continent, most of Australia and New Zealand, most of Africa and South America, a vast portion of Asia, including India, belong distinctly to the sunshine regions. Here solar power is bound to be extensively employed in lifting water from under the ground and from the deeply eroded channels of innumerable rivers.

Exact information concerning the underground water supplies is somewhat meager, since both public and private enterprise were naturally first directed to the diversion of streams and the employment of the smaller class of reservoirs. But during the past five years pumping has become the most aggressive feature of the irrigation industry in the West and the area of its operations has been rapidly widening. A large portion of the precipi-

(Continued on Page Seven.)