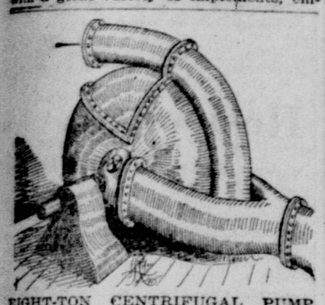
out. Previously he had invented a system and apparatus for transporting material through a pipe by means of a carrying stream of water, and to make this method of transportation available for dredging he had placed the apparatus on a lighter to be used alongside the dredger. A receiving apparatus had been invented to move with the dredger in the progress of the work, and in order to deposit the material there was rigged up additional apparatus consisting of a series of short sections of pipe connected with one another and with a stationary pipe on shore by pieces of flexible hose, the line being supported by pontoons. This latter portion reaches from the land pipe to the receiving and discharging apparatus, to which it was also flexibly connected with short pieces of hose.

Mr. Bowers had discovered that the carrying capacity of his transporting apparatus was largely in excess of the excavating capacity of the ordinary dredger, and he was seeking a mode by which the apparatus could be supplied with all the material it could carry away. He had learned that to secure the best results the material should be supplied not intermittently, but in small masses and in a continuous stream. The problem was not new to him. Time and time again he had wrestled with it, and on the night in question the new idea occurred, and before he slept, in the silence and darkness of the night, an invention had its birth. It was the modern system of hydraulic dredging.

Rising early in the morning Mr. Bowers drew on a piece of brown paper he found on the table a pencil sketch of his invention. Before lunch he had inked it and had written a description. It shows the entire system of hydraulic dredging, not with the perfected details of construction since wrought out by him and copied by the infringers of his patents, but with every essential principle now in use.

The Bowers system can be practiced with a gerat variety of implements, em-



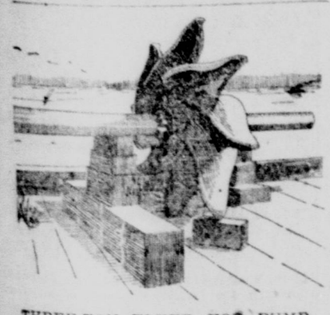
EIGHT-TON CENTRIFUGAL PUMP.

bracing the principles of cutting with any suitable tool, while swinging sidewise on a rigid radius and pivot, then bringing the excavated material on board the dredger and forcing it out again through a pipe to a place of deposit. The method preferred by Mr. Bowers, and adopted, it is believed by all or nearly all infringers of his patents, is to sever the material from the bottom of a waterway by means of a hollow rotary cutter or excavator, so constructed that the severed material passes between the cutting edges or blades to the mouth of a suction pipe leading to the hollow interior of the cutter; thence the material is drawn inboard and forced through the discharge pipe to any desired point, miles away, if necessary. The dredger, while working, swings on a massive self-contained pivot or spud, and with the cutter moves in the arc of a circle. When one arc is completed, the boat is moved forward by means of another spud, and the cutter describes a second arc, so that successive arcs are constantly being made and a clean bottom dredged.

The spud timbers in use on the Anaconda and Python are each 19x22 inches and 72 feet long, and are armed at the lower end with heavy steel points. The Anaconda has a swing of 200 feet and can dredge to a depth of 42 feet below the surface, while the big Python describes an arc with a radius of 225 feet and can work at a depth of 50 feet. From either side of the dredger forward to stationary piles guy ropes are thrown out, and as the boat swings from one side to the other and back again, the guy ropes, attached to a machine in the pilot house, wind or unwind, as the case may be. On completion of the arc described by the dredger the spuds are reset and the boat forced five feet forward and the cutter set to work again.

The cutter is at the outside end of a long tubular suction pipe that projects from the bow of the dredger and gives it the appearance of a battering ram. The cutter itself displays a formidable array of knives arranged in a circle and so adjusted as to be worked at any angle. It is 2 feet 6 inches in diameter, and 4 feet long, with thirteen blades on the side and seven on the end, and constructed precisely on the principle of an old-fashioned apple parer. In operating the machine great care is necessary to avoid large stones and boulders, and the practice is to watch carefully, and when the suction pipe begins to bound to slow down the machinery, going first to one side and then to the other of the obstruction until it is completely undermined. In doing this the dredger must literally "feel its way," for if it should go blindly at a ledge of rock the immediate effect would be that the suction pipe and cutter would go bounding along over the boulders, shaking the immense dredger like a leaf, and dragging it from its moorings perhaps to a great distance. Having once gone through the experience the operator will be extremely careful to avoid a repetition of the shock.

Almost in the center of the dredger is a centrifugal pump eight feet six inches in diameter, containing a nine-point "flyer" weighing three tons. The pump with all its equipment weighs twelve tons. Its office is to supply the power by which the material torn from the bottom by the cutter and suction pipe is forced through the stationary pipe line to the place of delivery. From the top of the pump rises the first joint of the receiving pipe forming the connection with the flexible line on the pontoons. Formerly this pipe on the dredger was carried over the boiler, then bent in a 90 per cent. curve downward, then thrown into another 90 per cent. curve along the bottom of the dredger to its connections, but experience has shown a more advantageous arrangement, and now the pipe is carried straight out by the spud cabin to the pontoon pipe, sixteen feet above the sur-



THREE-TON FLYER FOR PUMP.

face of the water. In this way the heavy resistance caused by the double curve is eliminated, and the entire "lift" is made at a point the nearest possible to the engine. There is also another circumstance of importance. The material from the cutter is at once elevated, and from the beginning of the stationary pipe line begins to descend, and in this way is formed an immense syphon of great power. It is calculated that the additional "pull" from the application of this well-known principle of mechanics amounts to about 20 per cent.

The pipe line through which the earth sliced up from the bottom of the bay will be forced is made up of sections with an inside diameter of eighteen inches. The stationary portion, or "shore line," is at present on a long string of piling, which commences a short distance south of the north end of the east waterway and describes a graceful curve toward the east and northeast, terminating at a distance of 2,100 feet, near the intersection of Railroad avenue and Charles street produced. It will be connected with the Anaconda tomorrow by means of the stretch of movable pipe mounted high on pontoons, which will allow the dredger to swing back and forth in the large semicircle, and at the shore end will be another movable line to regulate the discharge of earth behind the bulkhead. All along the line there is telephonic connection with the pilot house, and the least break or disturbance can quickly be reported to the captain in charge and the machinery stopped.

For the present, the work will be done by the Anaconda alone, but as soon as the Python can come out of the dry dock she, too, will take part in the excavating. The capacity of the dredgers, says Manager A. L. Horner, depends on the length of the delivery line, and the Python with a 1,200-foot pipe can discharge 15,000 cubic yards of earth in twenty-four hours, while the capacity of the Anaconda is about one-third less. The dimensions of the two boats in feet are: Anaconda, length 110, width 32, hold 10, draught 5; Python, length 120, width 34, hold 12, draught 6. The main engines used in the hydraulic work are of Westinghouse make, and are respectively 250 and 400 horse power. The Anaconda has worked all along the Pacific coast from San Diego north, while the Python has been confined in its operations to the Willamette and Columbia rivers. She was built at a cost of $116,000 four years ago at the Willamette Iron Works in Portland for the purpose of filling in Couch lake, the site of the Union railroad depot.

The late voyage of the Python from Portland required sixty-four and one-half hours actual sailing time, and the long journey for the unwieldy craft was made without a mishap. With the Anaconda a few years ago the result was different; nevertheless the vessel proved to be a staunch sailer and at the same time made a record for life saving. It was in the fall of 1888, when the dredger was on the way from San Diego to the Columbia river. Off the Oregon coast she encountered a heavy storm, and when the seas were at their height the men in the Anaconda, misunderstanding a signal from the tug, cast off the line, and the boat was left to drift helplessly about on the ocean. Eight hours passed before the dredger was again secured and was able to go forward on her voyage. A little later the lookout saw a ship's longboat tossing on the waves, and an investigation showed that it contained nine of the crew of the ill-fated side-wheeler Alaskan, which had been shaken to pieces by the violence of the gale and had gone to the bottom. Several of the crew had been drowned, and another boat load containing a dozen men later was cast upon the rock-bound coast at the foot of Cape Perpetua, just north of the Siuslaw. They were nearly famished when rescued by the Anaconda, and had lived for many hours on a few cans of peaches. The Alaskan, the twin of the fleet Olympian, was one of the greyhounds of the Columbia, and many a time after a brush with her competitors carried the broom at her masthead. Today a weather-beaten signboard painted with her name, though deserving of a better fate, lies, a mute relic of departed glory, upon the yellow sands of the Siuslaw just south of Florence.

GREAT BOON TO THE CITY

UNPARALLELED ADVANTAGES OF THE ENTERPRISE.

Best Harbor on the Coast, Finest Railway Terminals and the Lake Open to Commerce.

The advantages to be derived from the south canal and tide land improvements are greater and more various than the average man has any conception of, even if he devotes much thought to the subject. To explain them in detail would occupy a great deal of space, but they may be briefly summarized as follows:

1. The creation at Seattle of the best harbor on the Pacific coast, thus fixing beyond further doubt the city's position as the principal port of the Pacific Northwest and ultimately of the whole Pacific coast.

2. An increase of five miles in the water frontage of the city, and giving a total of thirteen miles on the Sound shore, measuring along the harbor lines and waterways.

3. The improvement of the harbor on a systematic plan so as to make it fill all the requirements of modern commerce, chief among which are direct and speedy connection between ship and rail, and wharves at which the largest ships can load and unload cheaply and rapidly without going into a dock.

4. The immense saving to wharf owners and persons having structures on the tide flats through doing away with the ravages of the teredo, the Duwamish waterways being supplied with fresh water which would flow northward along the existing water front.

5. The retaining in compact shape, all directly connected, of all the harbor facilities—the old water front, Duwamish waterways, canal and lake—all being closely adjacent to the present business center.

6. The creation of an area of 1,535 acres of level land directly adjoining the business center of the city, adjacent to deep water and all the railroads, so as to be perfectly adapted for manufactories, saw-mills and wholesale houses, shipping goods abroad by sea and to the interior by land.

7. The creation of abundant level area where railroads can establish their terminals and meet ships on the same level.

8. The immediate advantage to be gained by putting into practical effect the plat designed by Engineer Bogue and adopted by the tide land appraisers.

9. The removal of the present unsanitary condition of the flats, where sewage is discharged at high water line to spread out at low tide and fester in the sun and evolve poisonous gases. With the flats filled sewers can be carried through to deep water in the waterways and on the harbor line, where the sewage will be swept out to sea by the tidal currents, which act as a natural disinfectant. The large sewage area on the lake front and in the Rainier valley, which now discharges into the lake, will be drained into sewers running along the berms of the canal, which bisects the Rainier valley at its lowest point.

10. The opening to ocean commerce of the great body of fresh water in Lake Washington with an aggregate frontage of eighty miles, free from the teredo and tides, saving greatly in the cost of wharves and cleansing ships of marine growths.

11. The opening of the land along the shores of Lake Washington for manufacturing purposes, with ship and rail connection.

12. The laying bare of a strip along the lake front by the lowering of the water, on which a driveway can be established at slight cost, extending along the canal berms to the business section of the city.

13. The opening of Lake Washington as a great storage basin for logs, into which they can be dumped by all railroads touching its shores and which will be free from damage by the teredo or storms, as in the Sound, and from damage by floods, as in the rivers. Even if a boom should be broken, the logs could be easily recovered, while in the Sound they would be swept away and hopelessly lost.

14. The establishment of water transportation from the shores of Lake Washington and Lake Sammamish for agricultural purposes and mineral products and logs from the back country to the Sound. The lowering of Lake Washington will make it possible for the farmer to load his products direct from a barn on the shore to a steamer on the lake.

15. The prevention of floods in the White, Duwamish and Black river valleys and Squak slough, by reducing the permanent level of Lake Washington and diverting Cedar river into it, thus relieving the channel of the Duwamish at flood times. This would result in reclaiming large areas of agricultural land in these valleys, which are now submerged half the year, and also would reclaim a large area around the shores of the lake.

16. The purification of the water of Lake Washington by making the summer level its permanent level, and thus causing Cedar river to always discharge into it. This would make the canal practically an extension of Cedar river to the Sound, and its waters could be used for a gravity supply on the filled land.

17. The certainty that Lake Washington would be used by the government as a rendezvous for the Pacific coast squadron and for merchant vessels laid up on the coast.

18. The creation of facilities for building dry docks at minimum cost along the canal, the difference in level between the lake and the Sound affording an opportunity for the construction of a dry dock operated by gravity and capable of docking a vessel drawing twenty-eight feet of water.

19. The bringing to the front of Seattle as an unsurpassed shipping point, having abundant frontage on fresh water with access to the ocean and having all the materials at her gates.

20. The creation of a fine and conveniently-located water power available for any purpose.

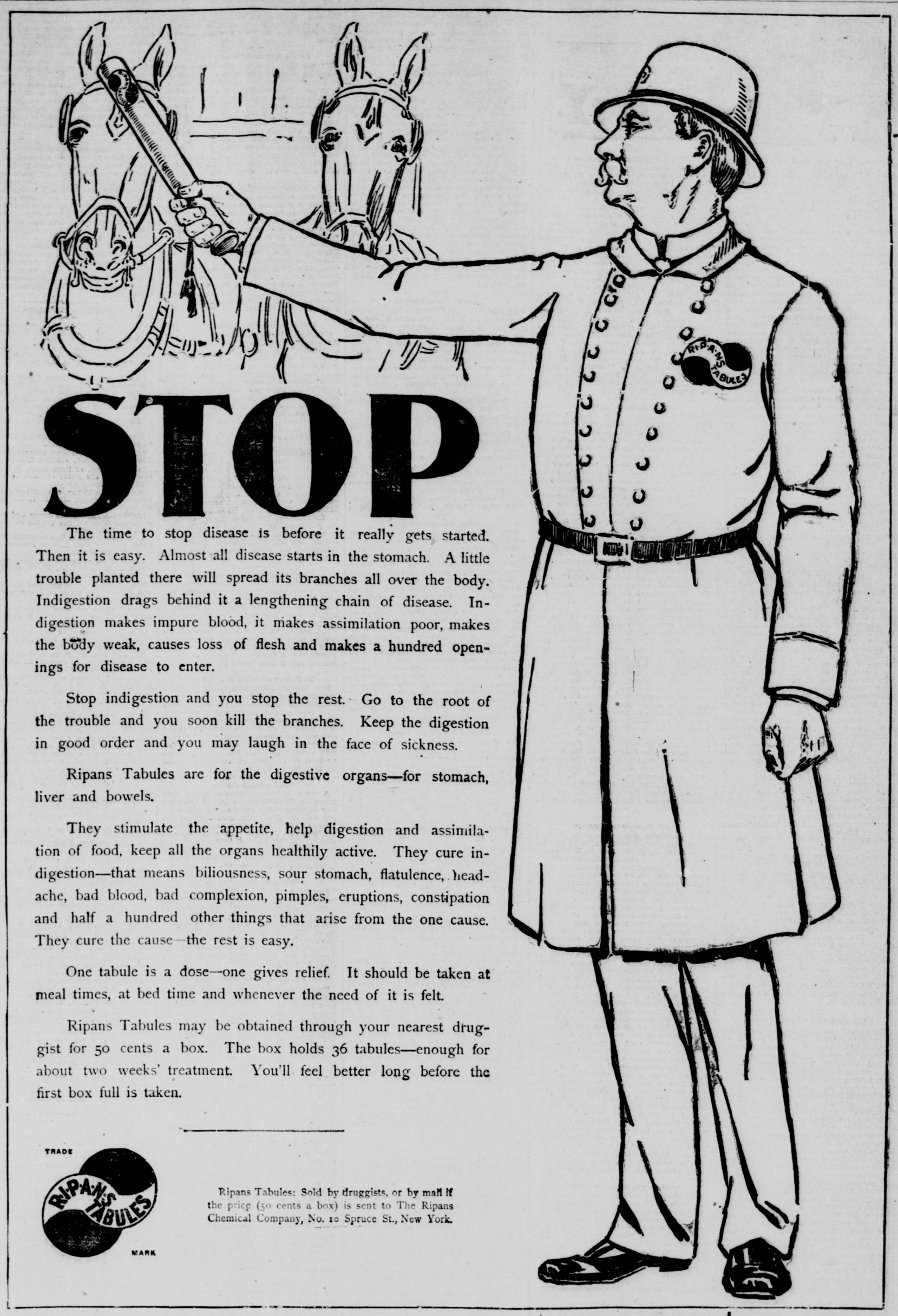
21. The accomplishment of gigantic and beneficial works, without the levying of a tax upon existing properties, but rather to the benefit of all existing properties in Seattle.

22. The completion of such works without a tendency to interfere detrimentally to any appreciable extent with existing values of improved property.

23. The furnishing of remunerative employment to a large number of men.

24. The general revival of business which will result from the expenditure of $7,000,000 in the city and from the reawakening of the old Seattle spirit of standing shoulder to shoulder for the good of the city.

25. The great indirect advantage through advertising Seattle the world over during the entire progress of the work as a great port, and through the high standing it will gain in the financial world by the readiness of the St. Louis people to invest their money here and by the confidence and enterprise of the people of Seattle as shown by their giving the subsidy.



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The time to stop disease is before it really gets started. Then it is easy. Almost all disease starts in the stomach. A little trouble planted there will spread its branches all over the body. Indigestion drags behind it a lengthening chain of disease. Indigestion makes impure blood, it makes assimilation poor, makes the body weak, causes loss of flesh and makes a hundred openings for disease to enter.

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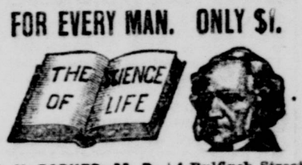

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