

New Sources of Pulp and Paper

The Direction in Which the Paper Maker Will Turn When His Timber Supply Is Gone

By Thomas J. Keenan, F. C. S.

THE growing scarcity and ascending cost of the raw materials used in the manufacture of pulp and paper are reflected in the prices which consumers are required to pay for the finished product. The larger city dailies appear to be less affected than the country weeklies and trade journals, for the reason, perhaps, that most of them obtain their supplies direct from the paper mills on long-term contracts, or else control mills of their own, the entire output of which is absorbed by them.

The body of all newspaper sheets consists of pulp produced by a mechanical process of grinding logs of spruce, balsam or hemlock against revolving stones in the presence of water. This pulp alone can be formed into paper with the addition of a small proportion of clay, but it is customary to strengthen the sheet by incorporating with the groundwood pulp a definite proportion—10 to 20 per cent—of chemical pulp made by the sulfite process. The preferred wood for the manufacture of sulfite pulp, which is made by boiling the wood under pressure, in bisulfite of lime solution, is spruce, though other woods, as hemlock, balsam fir, white fir and tamarack, are also used commercially.

The spruce and fir forests of the northeastern states, where our pulp and paper industry has had its greatest development, have been practically exhausted, and American paper manufacturers have been forced to seek supplies of this raw material in Canada. The Canadian pulp and paper industry has forged ahead of late years until its production of pulp and paper has reached enormous proportions, putting pulp and paper manufacture at the head of all the Canadian industries.

In addition to the pulp manufactured in our own mills for conversion into paper, a large volume is now imported from Scandinavia and Germany, as well as from Canada, our home production being wholly inadequate to meet the demands for the many kinds of paper which are manufactured in addition to newsprint paper.

Coincidentally with a diminishing supply of the woods which form the basis of newsprint paper, there has been more than a normal increase of consumption of this class of paper, owing to a greater use of newspaper advertising on the part of merchants and manufacturers.

Although there has been a good deal of ill-informed speculation concerning possible new sources of paper-making material, and many futile attempts have been made to utilize various reeds and grasses, waste paper, etc., the experiments of Brand, under the auspices of the United States Department of Agriculture in 1910, demonstrated the feasibility of converting cereal straws into a satisfactory paper pulp and commercial applications of the process or processes similar to it have already been made.

It is inevitable that paper manufacturers will turn eventually to sources of pulp other than timber, though for numerous kinds of paper trees will remain the preferred material. The use of cotton linters is a new and promising development. In the pulp and paper laboratories of the Forest Service at Madison, Wis., it has been proved experimentally that many western woods heretofore unused are well adapted for conversion into paper pulp by the processes ordinarily employed. Spruce can be replaced for pulp manufacture by twenty or more different woods, but the fact that it and trees similar to it take thirty-five or forty years to reach maturity is still a hindrance to their constant use. Timber trees cannot be treated as the agriculturist treats crop plants and be sown, cut and grown again as annual harvests, though some of the larger paper manufacturers have undertaken forestry work looking to the reproduction of wood on cut-over areas. The West Virginia Pulp and Paper Company, in this country, and the Laurentide Company, in Canada, were pioneers in conducting operations for timber conservation and insuring future supplies of papermaking woods. The solution of the problem is, however, to be looked

for in another direction. For years there has been used in the manufacture of tough papers, bag and wrapping papers, a fiber called Manila hemp, which is no hemp at all, but a species of banana, belonging to the Scitamineae family, the genus being *Musa*. Manila hemp is known to botanists as *Musa textilis*, while the edible banana of commerce is *Musa sapientum*. The leaf stalks of the various species of banana are rich in cellulose membranes which give them first place as available sources of paper stock, and it might be a profitable undertaking to plant the waste areas of the subtropical regions of our country, lower Florida and California, with the wild banana or other fiber yielding plants not heretofore employed as raw material for paper making. They could be treated as annual crops to yield a steady supply.

An American company has been formed for the utilization of fiber extracted from the wild banana by a new method involving the use of a fiber-decorticating machine which separates the fibers mechanically, and leaves them clean of incrusting material and ready for cooking in the pulp mill. The promoters of the enterprise are confident of developing within a few years a tropical industry capable of furnishing pulp and paper mills in the United States with a plentiful supply of papermaking material. Operations are now being conducted on a commercial scale in the Republic of Panama, near the Canal Zone.

Although reeds and grasses as raw materials for papermaking are of little importance at the present time, it may be said in favor of their use that the harvest is large and the plants are less subject to decay and rot in keeping than, for example, bamboo, banana and similar solid stalks which allow no ventilation in piling. Reeds and grasses are characterized by hollow cylinders which permit the passage of air and so obviate the decay resulting from the breaking down of vegetable matter which is more solidly massed in

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Correspondence

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The Gas Producer

To the Editor of the SCIENTIFIC AMERICAN:

Central stations in America operate a total of only 18,500 hp. in producer-gas engines, according to a recent estimate. This is a little under 10 per cent of the total of internal combustion engines in central power plants. The use of producer-gas in such places and in outlying plants should be much increased. Why is not more producer-gas used in America? In the SCIENTIFIC AMERICAN for Feb. 19, 1921, Ralph Howard discussed the shortage and waste of fuels, especially coal, and suggested the extended use of the gas producer or generator and internal combustion engine. He also stated that the practicability of this type of prime mover is not generally known, although it is constantly being improved. Mr. Howard gave a brief description of the apparatus and said that steam control, which is used to enrich the gas (carbon monoxide) has not been solved until recently.

It is rather a curious thing why, in this country where hundreds of thousands of tons of waste products, easily collected, are burned or dumped into the sea every year, manufacturers have not developed producer-gas plants similar to those so successful in England and Europe. Considering the limitations of the petroleum supply, and the ever increasing consumption of crude oil and its distillates, the subject of producer-gas is very opportune. We have enormous reserves of coal, yet the efficiency in burning under boilers is very low. Up to 1913 there had been considerable investigation concerning the use of producer-gas. In that year the U. S. Bureau of Mines issued Bulletin 55 by R. H. Fernald, covering the subject fully. There were then 722 producer plants, 610 burning anthracite, 77 bituminous coal, 32 lignite, 1 wood and 2 oil. The advent of the oil engine practically stopped development of producer-gas units. It appears that this type

of plant needed special fuels in order to reduce the labor charge. In fine, it failed to utilize low-grade fuels or waste products. The above-mentioned installations were mostly in the northeast and north-central states.

Australia, a country minus oil (so far) and little water power, also had a development of producer-gas plants from 1904 to 1912; since then their use has gained considerably. The fuels so consumed are charcoal, coal, coke and wood. These include lignite and 6-ft. lengths of fire wood. At the Waihi gold mine in New Zealand, six 200 hp. engines used producer-gas, the cost of power being 6 pence (12 cents) per hp.-day. British firms have advanced the operation of these plants, and now make producers and engines to work without trouble on such materials as charcoal, coconut shells, cocoa, coffee and rice husks, coke, cottonseed, corn cobs, olive, sawmill and sugar cane refuse, peat and wood. In America there are enormous quantities of such available. Consider the almost criminal waste at our sawmills, cane-sugar mills, flour mills, the neglected peat beds of North Dakota, and the refuse of a hundred and one industries. All can be converted into gas in the producer and drive engines in central plants and other localities where power is needed. The Bureau of Mines has published a number of bulletins and technical papers on the subject, so engineers interested should secure copies. Foreign practice is also discussed. There is nothing complicated or mysterious about the suction gas (producer-gas) system, and its further utilization is desirable as a conservation measure and for cheaper power.

MAX VON BERNEWITZ.

Brooklyn, N. Y.

An Appeal for Aid

To the Editor of the SCIENTIFIC AMERICAN:

I was approached some months ago by the present director of the Physical Laboratory at Bonn in behalf of his predecessor, the eminent physicist, Prof. H. Kayser. Professor Kayser has been recognized as the world's leading authority on laboratory spectroscopy and he is the author of the monumental work in six large volumes, published between 1900 and 1912. Upon his retirement last year at the statutory age for the University of Bonn, it proved to be impossible for him to live in any comfort on the depreciated pension allowed to him. It was therefore proposed that his re-

markable library of books and pamphlets on spectroscopy should be sold so that the money could be used for his personal maintenance. The value of between \$2,000 and \$3,000 was placed upon this library. It seemed to me that it would be much more appropriate for friends and admirers of Professor Kayser or others having an interest in the University of Bonn, who might be persuaded to buy the library and present it to the laboratory at Bonn, with the understanding that it was always to be at the disposal of Professor Kayser during his lifetime.

Professor Kayser's nature and characteristics are such that no one could assign to him any of the qualities which have been justly condemned in many of his countrymen during the late war. On the occasion of the 250th anniversary of the Royal Society of London he was one of the delegates from Germany at the numerous meetings of the celebration, and in an after-dinner speech at Cambridge his attitude was of a most friendly character to his hosts. Those were days in 1912 when tension was already beginning to be felt between Germany and England, and it may be recalled to the credit of some of the eminent physicists who were delegates from Germany that they brought as a testimonial of their regard for the Royal Society of London a special memorial tablet and address appropriate to the occasion. By one of the witnesses, at least, this was regarded as an expression of solidarity on the part of the German educators with their English colleagues.

I very much wish that this library could be saved for Professor Kayser's use and its money value be devoted to his comfort.

EDWIN B. FROST.

Yerkes Observatory,
Williams Bay, Wis.

An Old Catch Question in New Dress

To the Editor of the SCIENTIFIC AMERICAN:

Will you be kind enough to print the following question in your journal?

"A bird sitting on a perch in a cage is weighed together with the cage. How does this total weight compare with the weight of the same cage but with the bird flying in it? Why?"

Perhaps some of your readers will comment on this problem.

A. B. C.

Brooklyn, N. Y.

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the cup. While the cup was being made ready, the man in charge of the punching inserted the first die, duly greased; his assistant then placed the base of the cup in the die, the regulator valve was opened and the punch drove the cup through the die. As soon as the forging had been driven through, the die, which in the process had been raised and placed exactly in the axis of the cylinder, fell back in its seating and constituted a stop which helped to strip the forging from the punch as the piston traveled backward. The forging then fell on a gutter plate, whence it was removed and replaced on the punch when the piston was in the rear position.

During the time occupied in this the man in charge of the punching operations replaced the first die by a smaller second one, when the drawing down continued in practically the same way, the second die acting also for stripping the forging from the punch. The third pass proceeded in a similar manner, but before this, the forging was slightly reheated. During the drawing-down operations, the punch was cooled by water jets and the dies were freed of scale, cleaned, greased and placed in order for each successive operation.

Besides the regulator-valve handle, the engine driver had within easy reach an air-brake valve which was used to brake the driving wheels at the end of each revolution and to stop the crank on the rear dead-center. As soon as the forging had been driven through the die, and although the regulator-valve was immediately closed, the inertia of the driving wheels frequently resulted in two or three revolutions at comparatively high speed before the piston could be stopped at the back end of its travel. This resulted in somewhat heavy jerks which shook the wheel scotches; it sufficed, however, to inspect the position of the scotches every morning and to strengthen them where this was found to be necessary.

The installation ran successfully for about two years and produced several hundred thousands of 75 millimeter shells, pending the putting down of a more suitable hydraulic plant. It enabled the works, from the very commencement of the war, to do away with the manufacture of shells by boring out of the solid, thus saving a large quantity of metal, and much time and making the machine tools which would thus have been utilized available for other pressing munitions work.

An Alternative to Einstein

(Continued from page 468)

earth exactly; for that of Mars within 0.08 per cent. Corresponding figures for Einstein as his theories are superposed upon ordinary astronomical practice are 0.2, 37.5, 0.2 and 0.4 per cent. In the cases of the inclinations of Mercury, Venus and Mars Dr. Poor has discrepancies of 0.15, 1.8 and 5.3 per cent, while Einstein's discordances inherited from older theory are 5.3, 9.8 and 0.4 per cent. In the matter of the nodes Dr. Poor's debts to observation amount to 0.04, 0.06 and 0.15 per cent, and Einstein's inherited difficulties come to 6.8, 0.6 and zero per cent. We may remind the lay astronomer that the earth has no inclination and no nodes because it is always in its own orbit, whose plane measures these items in the other planets.

Dr. Poor has the advantage in eight cases out of ten; if we try to weight his advantage by the usual method of least squares, he has the better of the argument on a basis of about 30 to 1. Controversially it might be maintained that he has given the Einstein theory a fair run, since the results attained by it and quoted in the above discussion are stated by its proponents as ground for accepting it. As a matter of fact, however, Dr. Poor's own system is simply the Newtonian system, allowed the benefit of greater exactness than it has

ever before enjoyed. For a fair comparison, we must of course allow Einstein the same benefit. If we go independently through the operation of determining the characteristics which the solar envelope would have to possess in order best to reconcile calculation under the Einstein law of gravitation with the observed facts, we arrive of course at a different distribution of the zodiacal material, but one equally in accord with physical possibilities; and if this distribution be realized, Einstein's discrepancies are greatly reduced, but are still greater than those of the Newtonian theory as reinforced by Dr. Poor. In place of a thirty to one comparison, there is now a preference of three or four to one in favor of Dr. Poor according to the least square verdict.

For the benefit of the layman who does not realize as clearly as he might just what the scientist means by an assumption, it ought to be emphasized that Dr. Poor does not present these calculations as proof or even as evidence that the material of the solar envelope is arranged thus and so. He might with some show of provocation make this claim, in view of the fact that Einstein's hypotheses are often held by his followers to be proved by the verification of one or two of their consequences; but he carefully refrains from any such unjustifiable claims. His whole purpose is merely to prove that Einstein's assumptions are not necessary to account for the behavior of the planets. He proves this by showing that if instead of assuming the things that Einstein assumes, we assume something else, the observed facts are accounted for as well as by Einstein's postulates, if not actually better. If the zodiacal matter is arranged as Dr. Poor suggests, Einstein's theory is superfluous and in fact hardly tenable. That is all Dr. Poor has attempted to show, unless we make some reservation in connection with his efforts to point out that the arrangement which he discusses is entirely a possible one and in full accordance with what little we know of the distribution of the circumsolar matter.

In the present state of knowledge, then, we must say that the planetary motions do not furnish a definite test of the validity of Einstein's hypothesis or of Dr. Poor's hypothesis. It becomes a problem of observational astronomy to push investigation to the point where one or the other of them may be disproved. Until then, the proponent of either system may say that it fills the bill with an accuracy that satisfies him, that its assumptions appear to him to be reasonable, and that its subsidiary features are such as to make it appeal to him more strongly than the other—but he may go no further than this so far as the evidence of the planetary motions is concerned. The writer believes that the subsidiary features of Einstein's theory weigh so heavily in its favor as to leave little choice; but that is only an opinion. Such opinion, or even a universal consensus in the same direction, would not be competent to eliminate Dr. Poor's suggestion, which can be disqualified only by direct observational evidence disproving one of its assumptions or one of its consequences.

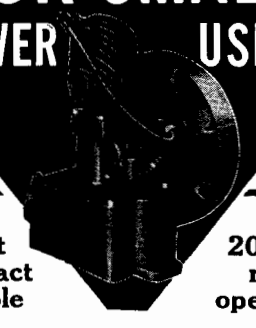
New Sources of Pulp and Paper

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the bamboo and other plants named. In reeds and grasses the cellulose membranes are less permeated with lignin and a smaller quantity of alkali is consequently required for their reduction to paper pulp than is the case with woods or plants of solid stems. In Germany, Czechoslovakia, and Roumania, the stalk, sheaths and leaves of Phragmites and Typha have been used for the preparation of cellulose with satisfactory results. The root stock of Phragmites is made to yield alcohol before being pulped.

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the waste from mat factories might also be experimented with. The dried plants are best adapted for use, since the green material contains coloring matter which makes bleaching difficult and expensive. Before harvesting the plant it should be allowed to stand from the actual time of ripening until winter sets in. This permits a more thorough drying and the mechanical action of air and cold favors the rupturing and weathering of all the cell constituents. The stalk and sheaths of the plants are considered the most suitable materials for pulp on account of their higher yield of cellulose fibers, amounting to between 30 and 35 per cent.

The cells of which the fibers of reeds and grasses are composed are short, rather wide in proportion to their length, and thin-walled. While these characteristics render the fibers unsuitable for conversion into the finer grades of bond and writing papers, they facilitate and cheapen the production of the pulp for purposes for which it is suitable.

It is not an idle dream to look forward to a time when pulp and paper manufacturers will have abandoned their present methods of obtaining cellulose fibers and treat paper pulp as a by-product of manufacture rather than a main product. From the tree or plant a whole range of valuable organic derivatives might be first extracted, leaving the cellulose, cell walls or skeleton of the plant to be utilized last of all. It is the tendency of modern methods of manufacture to proceed in this way, but it must be confessed that it is a far glance into the future where the paper industry is concerned.

As has been pointed out by Steinmetz, it is not so long since the coal tar produced in coke ovens was thrown away as a useless waste material. In the manufacture of sulfite pulp, the waste liquor of the cooking process is regarded similarly and the great bulk of it is washed into rivers and water courses to their pollution, only a small quantity of the available material being utilized as roadbinders, or for cementing foundry cores, and still less as a source of alcohol after fermenting the sugars contained in it. May it not be, that like the former waste product, coal tar, sulfite waste liquor may yet be made to yield many valuable organic chemical substances and evolve a new and profitable industry?

Sixty Tons Per Minute

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trimmer device has maximum dimensions of 7½ by 9 5/6 feet. It will go into pretty much any hatch larger than 8 feet 11 inches. The trimmers are electrically operated. They are a product of the designing ability serving the railroad.

Some may think the throw of the trimmer very likely to break up the coal. It should be remembered, however, that the most of the throwing is done in directions not greatly different from the horizontal. In other words, the coal may be thrown a fair distance horizontally, but drop only a short distance vertically. It is the drop that is mostly responsible for breakage. In fact, the operation of the trimmer is a good deal like that of a man throwing coal with a shovel. Only, in this case, the shoveler is a giant of a fellow.

The great pier is a notable affair of concrete and steel. It is built low and by this style of construction avoids the excessive cost incident to the building of great tall steel structures like those at Hampton Roads. On the other hand, there is perhaps a greater amount of power-driven apparatus connected with the Baltimore pier. The capacity is reckoned at 12,000,000 tons per annum—that is, about half the tonnage transferred from rail to ship either at New York Harbor or at the harbor of Cardiff, Wales. It is understood that, if this pier were now to be constructed, the cost would be double the \$2,500,000 actually expended.

Valuable Binder Material from Waste

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tons capacity each without incineration or objectionable odors or fumes. Any tonnage of garbage can be handled according to this arrangement, and within a period of eight hours the entire volume of refuse can be disposed of without cooking. This is a great improvement on the many methods of garbage disposal now in use.

The incineration system of handling municipal wastes of this description always was very expensive and generally unsatisfactory. The reduction method which features special treatment to obtain the oils and fertilizing materials contained in the garbage is also very costly and generally is maintained at a loss in cities which follow this plan. The practice of feeding garbage to hogs is yet in an experimental stage and is not adapted for general practice due to the variation of local conditions in different cities. These facts all combine to endorse the new method of garbage disposal now opened up. Of course under actual operation, this method also may develop weak points but, at present, it looks like the prize method of the lot.

Cardboard treated with this binder and then placed in boiling water for two hours has been used as a container for oil without any signs of leakage for over ten months. Some of the coarser cotton clothes which have been treated with this adhesive have withstood the wear and tear of emery wheel tests under laboratory conditions which would mean rack and ruin to similar cotton clothes before being treated. Cement sacks have been made and tested thoroughly which not only are water- and moisture-proof, but which also are more durable than the bags of this kind now in use. It costs only six to seven cents a hundred pounds to water-proof ordinary paper with this substance. Paper and fabrics treated with it not only resist water and acid penetration but also are proof against the entrance of oil or chemicals. In one corner of the Mohler testing laboratory are three concrete tanks which were treated on the interior. They have been filled with crude oil, kerosene and gasoline, respectively, for the last ten months and as yet there are no evidences that any of these materials have actually penetrated the cement walls.

The Current Scientific American Monthly

(Continued from page 473)

artificial pearls. The "orient essence" used for coating glass beads was taken from certain fish caught in French and Russian waters. When this supply was cut short by the war, American manufacturers besought the aid of the Bureau of Fisheries which discovered that the scales of the shad and the sea herring were capable of furnishing as choice an essence as those of imported fish, and now artificial pearls are being made from a product of American waters.

"Warming Buildings with Refrigerating Plants" is the title of an article by Robertson Mathews of Cornell University, in which he shows how our vast natural supply of low temperature may be utilized.

In view of the coming attempt to scale the heights of Mt. Everest, special interest is attached to the article on "Mountain Craft," which goes into considerable detail in explaining the regimen, walking manners and equipment for mountain climbing.

In addition to the over score of articles and numerous notes, the June number contains the usual departments, giving the latest progress in science and various branches of technology.

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