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Contents.

(Illustrated articles are marked with an asterisk.)

FILTH AS THE SOURCE OF PREVENTIBLE DISEASE.

In his charming little poem, preaching resignation to the stroke of the "Reaper whose name is Death," Longfellow says:

"Let us be patient: These severe afflictions
Not from the ground arise:
For oftentimes celestial benedictions
Assume this dark disguise."

This has ever been the sentiment of piety: beautiful in the abstract, comforting in times of personal bereavement, but a deadly delusion when applied in mass. Not patience but impatience, not resignation but resistance, is the proper attitude in the presence of disease and death, more especially in those cases—and they are in the majority—in which the causes of "these severe afflictions" are preventible or removable: causes which, poetry and piety to the contrary notwithstanding, do from the ground arise.

This is a question of fact, not one of sentiment. The Mussulman says: "It is the will of God," and impassively shuts his eyes to the palpable causes of plague, pestilence, and famine, which shorten the lives of millions. The Christian, quite as criminally, dreams of possible "celestial benedictions" in conditions which contribute to make the average death rate double what it ought to be, while he holds up his hands in holy horror at the apathy of the Turk.

It is appointed of all men once to die: so far we have to submit to natural law, and there may be virtue in accepting the event with resignation—provided it does not come untimely: but there can be no virtue in being resigned to a condition of things by which not ten persons in a hundred, in the healthiest countries in the world, are permitted to reach the standard old age of seventy-five years. by which the death rate of the first year of infancy is swollen from one in twelve, as it is in some districts, to one in three, as it is in others. And the excess of deaths is but an imperfect measure of the aggregate influence which preventible diseases exert against the efficiency and happiness of a people. There remains an incalculable amount of physical suffering and disablement, of sorrow and anxiety, of thwarted effort and straitened means, not to speak of destitution and pauperism and their terrible effects upon the physical virtue and moral stamina of the rising generations: all to be traced directly or indirectly to easily preventible causes.

Foremost among the causes which affect the public health injuriously—causes not of local, but of general, almost universal, operation—the Medical Officer of the Privy Council finds most conspicuous these two "gigantic evils," which claim the "earliest attention in the sanitary government of England," and equally, we may add, of every other civilized government, namely:

First, the omission (whether through neglect or want of skill) to make due removal of refuse matters, solid and liquid, from inhabited places; and secondly, the license which is eprmitted to cases of dangerous infectious diseases to scatter abroad the seeds of their infection.

Very frequently these two causes coöperate, doing immense injury to the public health, through the special facility which certain forms of local uncleanliness provide for the spreading of certain specific infections: so that, on summing up the results of the extensive and very able investigations of sanitary conditions, made under his direction, Dr. Simon does not hesitate to say that, in total power, uncleanliness must be reckoned as the deadliest of our present removable causes of disease. This, even when the term is restricted to such degrees of uncleanliness as fall or ought to fall within the designation of filth, implying nastiness such as any average man or woman should be disgusted at. If the term were made to include all that it legitimately implies, as for example the foulness of air due to the non-removal of the volatile refuse of the human body, such as obtains in overcrowded and ill ventilated dwellings, a much stronger expression of its fatal influence would be justified.

That filth makes disease, meaning by filth putrescent refuse matter causing nuisance by its effluvia and soakage, must have been one of the earliest of social discoveries, for it is recognized in the oldest records which exist of legislation meant for masses of mankind: yet the more subtile and destructive effects of filth remained unsuspected almost until quite a recent period.

Filth kills in two ways. First, and most obviously, by a direct poisoning action, as when one succumbs to the concentrated fumes of organic decomposition from an old unventilated cesspool, or a long blocked sewer, or when the vigor of life is depressed by continuous breathing of a foul atmosphere in which the fetid gases have been largely diluted; second, with far greater and more subtile destructiveness, by means of the morbific ferments or contagia which it breeds or harbors. The chemical poisons of filth hurt by instant action, and in direct proportion to the palpable and ponderable dose: with contagia, on the other hand, indefinitely large ulterior effects are produced by, or by means of, doses which are indefinitely small.

The last named agents of disease and death consist, so far as known, in minute living organisms, indefinitely self-multiplying in their several spheres of operation. At least one sort, the ordinary septic ferments, seem always to be present where putrefactive changes are in progress; others, though not essential to putridity, are in different degrees apt, and some of them little less than certain, to be incidents of ordinary refuse. It is by these various agencies, essential and incidental, that filth produces the diseases classed by sanitarians as zymotic, and not by means of the usually accompanying stench. Hence, as Dr. Simon tersely observes, the question: What infecting powers are prevalent in given atmospheres? should never be regarded as a mere question of stink; and it is of the utmost practical importance to recognize, in regard to filth, that agents which destroy its odor may yet leave all its main powers of disease production undiminished. On the other hand, there may be prevalent fetid gases of the most sickening potency with an entire absence of septic ferment in the air.

Indeed filth ferments show no power of active diffusion in dry air. They may be passively wafted for short distances, but probably do not carry their vitality far if the air be freely open. Moisture is their normal medium. Currents of humid air, as from sewers and drains, lift them in full effectiveness; and if into houses or confined exterior spaces, the chances are that their morbific powers will be less preserved. Ill ventilated and low-lying localities, where refuse is allowed to lie, may especially be expected to have these ferments present in their common atmosphere, as well as teeming in their soil and ground water.

In the latter, too, as in the air, stench and palpable foulness afford no adequate test of zymotic malignity. Chemical demonstration of unstable nitrogenous compounds in water is a warning (and the disgust of healthy taste and smell equally so) which should never be disregarded: "but till chemistry shall have learnt to identify the morbific ferments themselves, its competency to declare them absent in any given case must evidently be judged incomplete, and waters which chemical analysis would probably not condemn may certainly be carrying in them very fatal seeds of infection."

Of the diseases distinctively due to filth, the most characteristic are those which, in respect to their leading symptoms, are called diarrhœal. These are of two general types—common diarrhœas, ascribed to the common septic ferments generated in all refuse, and specific diarrhœal diseases, such as cholera and typhoid fever due to specific infection. It is in regard to the latter that the labors of the British Medical Board have been especially searching and successful.

In every one of the cases investigated, the relations of water supply and excremental deposits were horribly close in very many instances, as for example at Annesley, of which the inspector, Dr. Buchanan, reports, "arrangements for excrement disposal and water supply such that people must drink their own excrement!" Truly the chief medical officer may well say that it is difficult to conceive, in regard to any causation of disease in a civilized community, any physical picture more loathsome than the way in which enteric fever spreads its infection. Though sometimes making its way by covert processes, yet far oftener in the most glaring way, it apparently has its source in that which is of filth the filthiest: "apparently its infection runs its course, as with successive inoculations from man to man, by instrumentality of molecules of excrement which man's filthiness lets mingle in his air and food and drink."

The distribution of an immense quantity of other diseases is traced to the same disgusting process. The argument which applies to the bowel discharges of enteric fever apply equally to cholera, and seems to extend, by extremely strong analogy, to every disease, whether nominally common or specific, in which the human intestinal canal is the seat of infected change.

But this does not limit the deadly influence of filth. The researches of Dr. Burden Sanderson and others have clearly shown that in the common septic ferment, so called, or in some ferment or ferments not hitherto to be separated from it, there reside powers of disease production as positive as those which reside in variolous or syphilitic contagia. By successive inoculations, it not only develops itself as one of the most tremendous of zymotic poisons, but becomes communicable from the sick to the healthy, producing diseases exactly corresponding to the fatal infections chiefly known under the names of erysipelas, pyæmia, septicæmia, and puerperal fever: infections sometimes arising in unquestionable dependence on filth, yet becoming, when arisen, the most communicable of diseases. And further, it seems most probable that the ferment which destroys life so quickly by septicæmia in its stronger actions can in slight actions start, in the infected body, chronic processes which will eventuate in general tubercular diseases. In this way the mischief done by filth in generating diseases like erysipelas or puerperal fever on the one hand, or tubercular diseases on the other, may be of a sort entailing possibilities of extension, by accidental contagion or by hereditary transmission, indefinitely beyond the original filthy neighborhood.

WHAT FILLS THE INTERSTELLAR SPACE?

That the interplanetary and interstellar space cannot be a perfect vacuum, or consist of absolutely nothing, is clear from the fact that light and heat are propagated through it; and whether we accept the old theory of Newton, that light is an emanation of fine particles, or the now generally accepted undulatory theory of Huyghens, that it is propagated by waves through an existing medium, we are driven in either case to the conclusion that there must be a something pervading the whole Universe (outside of the luminous and dark spheres which are suspended in it at various distances apart) to its furthermost recesses. It has usually been agreed to call this something the celestial ether, and even different kinds of such ether have been supposed to exist: one to propagate light, one for heat, one for electricity, one for magnetic effects, and some philosophers have even suggested one to produce the phenomena of gravitation; and they have been respectively called the luminiferous ether, imponderable caloric fluid, electrical ether, magnetic fluid, etc., and even some of our foremost savants still indulge in the use of such hypothetical expressions.

It may be that this something which fills space is composed of a number of elements, in the same way as our atmosphere consists of nitrogen, oxygen, carbonic acid, and watery vapor; but it is also possible that it consists of a single substance, capable of transmitting various kinds of motions, as our atmosphere, without reference to its chemical constituents; it transmits waves of sound of various pitch and character, various pressures, currents of different velocities, etc. It is sufficiently well established that light, heat, and electricity are only modes of motion differing in character, being for instance progressive, circular, elliptical, to and fro, rotary, longitudinal waves, transverse waves, etc.; therefore it is possible that the same interstellar medium may transmit light, heat, attraction of gravitation, electricity, magnetism, and possibly other forces as yet unknown to man.

In the meantime, it forms an interesting subject of inquiry if this medium is absolutely without weight, and therefore of a nature different from what we call matter, of which weight is the first and fundamental property, or if it may be considered as very rarefied matter, so highly expanded that it is to our hydrogen as hydrogen is to platinum. The latter is, at the common atmospheric pressure, 250,000 times heavier than hydrogen, and we can easily reduce its density (by means of an air pump) to a one hundredth part, as is done in the Geissler tubes, which, when illuminated with an electric current, show the characteristic spectroscopic lines of hydrogen; and notwithstanding this still ponderable material has a density of only the twenty-five millionth part of that of platinum, it will, when condensed again, show all the characteristics of its nature, enter into chemical combinations, exert pressure, etc.

It is well known that our ancestors, a few centuries ago, had no conception of the gravity of gases in general, still less did they attribute weight to rarefied hydrogen, and even now, for the savage mind, such a thing has no existence; and it is a question whether even we, the enlightened and supposed to be well informed savants of the nineteenth century, do not stand in the same ignorance in regard to the gravity and other properties of the interstellar medium.

The modern theories of the conservation of forces and the transformation of heat into power, and *vice versa*, considered in connection with the velocity of the transmission of the solar rays and with the amount of heat poured out by the sun, which has been correctly measured (and which is the primary source of all motion and life on our planet, except the motion of the ocean tides), may give some light on this subject. As the heat of the sun is sufficient to melt half an inch of ice per hour, or 72 cubic inches for every square foot of surface, which is equivalent to $\frac{1}{24}$ of a cubic foot, or nearly $2\frac{1}{2}$ lbs., and as the melting of 1 lb. of ice con-

sumes 142 units of heat, the solar rays exert a heating influence of $2\frac{1}{2} \times 142 = 355$ units of heat per hour on each square foot. But as 1 unit of heat is equivalent to 772 foot pounds, we have for the solar action a force of 274,040 foot pounds per square foot per hour, or 80 foot pounds per second. It has been demonstrated that light moves with a velocity of 192,000 miles, or very nearly 1,000,000,000 feet, per second; and calling the weight or mass of the molecules (which, according to the Newtonian theory, are emitted from the sun) $= x$, we must, to ascertain the mechanical momentum of the effect of this transmission, multiply the mass with the square of the velocity; and as this momentum is found equal to 80 foot pounds per square foot, we have the equation: $1{,}000{,}000{,}000^2 \times x = 80$, from which it follows that $x = 80 \div 1{,}000{,}000{,}000^2 = 0.0000000000000008$ for the mass of a column of the interstellar medium 192,000 miles, or 1,000,000,000 feet, long and of 1 square foot section Dividing this value of x by 1,000,000,000, to find the weight of 1 cubic foot, we see that it will amount to 0·00000008 lb. As the weight of 1 cubic foot of hydrogen is, at the ordinary atmospheric pressure, 0·0021b., we see that, if these calculations are worth any consideration, the weight of the interstellar medium is about a million times less than hydrogen; therefore it is utterly inappreciable by our most delicate balances, but still very appreciable by calculation and observation. If we accept the Huyghenian theory of light transmission by waves, the mechanical effect of the luminous waves, striking with the demonstrated velocity of light (notwithstanding that its calculation involves more complex and difficult questions), will give results not very different from the above estimates; and these make it highly probable that the specific gravity of this interstellar medium is not absolutely zero, but stands in about the same relation to rarefied hydrogen as rarefied hydrogen does to platinum.

FOREIGN PATENTS—SPLENDID OPPORTUNITIES FOR AMERICANS.

We would direct the attention of inventors to the large reductions which have been made in the expenses pertaining to the securing of patents in foreign countries, as fully set forth in the advertisement of Messrs. Munn & Co., published on another page. It is not realized as thoroughly as it should be that the world, and not any one political division of it, is the inventor's legitimate field; that an original and useful device is likely to be as valuable and as profitable in one civilized country as in another; and therefore for the possessor of the same to attempt to glean its full advantages, from its working only in the United States, is as shortsighted as would be the course of a wholesale merchant who should reject all trade except within the limits of the town or city in which he resides. Add to this that American inventions have acquired an enviable reputation abroad, and are eagerly sought after, and an opportunity is offered for making money infinitely superior to that presented in the territory from which a dealer in other men's wares must literally discover and extract the means of establishing a business.

But apart from all these considerations, it is certain that at no period since patents have been in existence has the acquirement of foreign protection for his device been more vitally important to the American inventor than at the present time and during the coming year. All the world knows that in a few months such a display of new and ingenious inventions as has never before been witnessed will be exhibited at Philadelphia. Every means of making this Exposition known has been adopted. The foreign newspapers are filled with preliminary accounts of the buildings, and with anticipations of the grandeur of their contents. Our home journals are constantly on the alert to give to the public the latest intelligence of the progress of the enterprise. Nearly all the great governments of the world are getting ready exhibits of the finest productions of their several countries, and, finally, thousands of people, including probably all most prominently interested in invention and in industrial progress, will personally make the journey to the Centennial. The machine builders of England and France, the iron producers of all the European countries, capitalists from abroad ready to invest in and promote the advancement of new and useful ideas, all will scrutinize with the utmost interest our national display, and seek to profit by it. Skilled foreign engineers will examine every detail of the mechanism, ingenious foreign inventors will contrast their devices with ours, and note the improvements, and, in brief, we may venture safely to say, of each and every American invention of merit in the Exposition, there will be many scores of people who will have its every feature impressed on their memories, if not accurately portrayed in their note books. What then is to prevent these people from returning to their own countries and, with all the data before them, reproducing every American device, and reaping a rich harvest in return? Nothing but the protection of the foreign patent, of which the American inventor may now avail himself; and if that patent is not secured, he must be content to stand aside and see his ideas appropriated.

The advantage of the foreign patent does not, by any means, end with the prevention of piracy at the Centennial, important as such effect may be. It renders every particle of the enormous amount of advertising done for the Centennial as valuable to the inventor as if it had been done for his individual benefit. It changes every foreign visitor, coming from the country where he has protection, from a possible pirate into a probable customer. It brings him a new clientage, limited only by the population of the nation; and if his patents are obtained in four great countries—England, Canada, France, and Belgium—a hundred million people are tributary to his monopoly. His interest will then be to display the new and original advantages of his productions, not to keep them back; to distribute descriptions and drawings broadcast, instead of nervously watching every stranger who dallies with pencil and notebook; to court inquiry relating to his invention, rather than to avoid the same.

We think that there are few American inventors who will not appreciate the importance of this matter. It is a simple duty, easily attended to, and, as will be seen from Messrs. Munn & Co.'s announcement, the facilities of the largest patent agency in the world are now placed at every inventor's disposal, at an expense less than ever before, and certainly inconsiderable in view of the advantages to be gained.

"WRINKLES AND RECIPES."

We have never actually counted the number of questions which the SCIENTIFIC AMERICAN is called upon to answer through its "Notes and Queries" column; but it is no exaggeration to estimate these at several hundreds weekly. It is of course impossible for the editors to reply to all in full: first on account of the space at their disposal not being unlimited, and second because large numbers of the queries have been previously answered in its columns. Many readers, however, from various causes, either do not possess or have not access to the back files of the SCIENTIFIC AMERICAN; and it is to benefit these, as well as to place in the hands of mechanics generally a plain, precise, and practical handbook, in which the queries which form the very large majority of those constantly received at this office will be found fully and completely answered, that *Wrinkles and Recipes* has been projected.

The volume is divided into five departments, namely, Mechanics, Engineering, Practical Technology, the Farm, and the Household; and while embracing under these general headings a large amount of the most valuable and practical information which has appeared in the SCIENTIFIC AMERICAN, rewritten and condensed with care, it also contains a goodly proportion of entirely new material, prepared expressly for its pages. For example, under the division of Mechanics, will be found fine engravings of a set of master tools, forged at the request of the editor by Mr. Joshua Rose, and experimented upon by him until their form was such as to give the fullest possible duty. The perfected tools were placed before the artist and reproduced with the closest accuracy in point of size, etc., so that, with the complete instructions given in the letter press, any mechanic can make them for himself. These tools are adapted for metal turning, boring, etc. In the same department is also the cream of the series of papers on Practical Mechanism, which during the last two years have appeared in the SCIENTIFIC AMERICAN, also selected and rewritten by their author, Mr. Rose. In the Engineering department is a new paper on testing metals, expressly written by Professor Thurston, and also a series of illustrated articles, with practical rules on steam engineering topics, prepared by Mr. R. H. Buel. It is believed that the brief treatises on the slide valve, the indicator, on testing engines, and on the governor, are the simplest as well as the most practical expositions of these subjects extant. The department of Practical Technology, compiled under the supervision of Professor P. H. Vander Weyde, embraces recipes of all descriptions, for metal working, for cements, alloys, and glues, for electrical batteries, and on hundreds of other practical subjects. Under the head of the Farm are given suggestions of all kinds useful to farmers; and in the following department of the Household, the housekeeper is provided with an invaluable repertory of useful hints. Especial attention has been devoted to "trade wrinkles and secrets" of which a large number are presented in the Mechanical department.

Altogether the work is one of the most useful guides for the classes to which it is addressed that has come under our notice; and it is sold at a price ($1.50) which places it within almost everybody's reach. It comprises 250 pages, neatly bound in flexible grease proof covers for the pocket. Copies may be obtained, post paid, by mailing the price to H. N. Munn, publisher, P. O. Box 772, New York city. See advertisement on back page

VENEERED DIAMONDS AGAIN.

Sydney Smith once observed that it required a surgical operation to get a joke into a Scotchman's head. We do not know whether the anonymous individual who has just sent us a letter signed "A Friend" hails from the land o' cakes; but we fear such must be the case, in view of the merciless hauling over the coals which he inflicts upon us for our recent innocent remarks on a cheap jewelry swindle. We might endure the letter in silence and lock the suffering it causes in our lacerated breasts, but now the veneered diamond man himself twists our paragraph into a commendatory testimonial, and publishes it as such in his brazen advertisements.

Seriously, however, for the sake possibly of others who may also have misunderstood our meaning, and in order to furnish the diamond(!) merchant with a new paragraph for future advertisements, we may plainly state that the wonderful discovery is a miserable deception. Science has never been able to produce the diamond artificially, though countless attempts have been made. Professor Silliman, by the aid of an intense heat, has made little globules from plumbago, which were transparent, and which resembled the genuine stone; so also globules have been obtained from apparently fused charcoal, but close examination showed them to contain iron and carbon, which proved that the charcoal had never been perfectly fused. Dr. Hare, of Philadelphia, by means of a deflagrator, succeeded in obtaining a metallic luster from intensely heated charcoal. Cagniard de Latour pretended to have discovered the ingredients of the gem; but the small crystals shown by him turned out to be peculiar silicates, which polarized light differently from the diamond. M. Despretz has conducted experiments which are probably the furthest advanced of any. By voltaic action he prepared a pure carbon from sugar candy, which was deposited in the shape of microscopic crystals in black octohedrons, or colorless translucent plates, the whole of which had the hardness of the powder of the diamond, and which disappeared on combustion without leaving any perceptible residue. Being, however, only in powder, it was impossible to isolate and weigh these crystals, or to determine their index of refraction or angles of polarization, the two tests which infallibly distinguish the true diamond. It is reported, also, but we know of no confirmatory evidence, that a mixture of chloride of carbon and alcohol, when acted upon by galvanic currents for six months, is decomposed with a result similar to the above.

As regards the ridiculous theory of the humbug we have referred to, certainly no refutation of it is necessary. We have a better opinion of the scientific knowledge of the readers of the SCIENTIFIC AMERICAN, and of our journal itself as an educator, than to credit the idea that others, beside those few intensely matter of fact persons who have written, wondering that we could be so humbugged, will be deceived by so palpable a fraud.

SCIENTIFIC AND PRACTICAL INFORMATION.

ILLUMINATING GAS FROM CORK.

To the list of substances capable of furnishing illuminating gas of good quality, cork is now to be added. Recent experiments, made in Bordeaux, France, have given results both economical and satisfactory, and it has been definitely decided to use the material in the lighting of the city. Works for burning cork are now in process of construction. The fragments of cork, principally waste left after cutting bottle stoppers, are distilled in a close retort. The flame obtained is stated to be whiter and more brilliant than that of coal gas, while the blue zone is much smaller, and the density considerably greater.

A SOLAR ENGINE.

M. Mouchot has recently exhibited to the French Academy of Sciences a simple form of solar engine. It consists of a cone of polished tin, reversed and arranged so that its interior can be adjusted toward the sun. In the axis of the vessel is suspended a large flask of white glass, inside of which is a metal boiler covered with lampblack. The rays, concentrated by the mirror-like surface of the cone, traverse the glass easily, and are accumulated on the boiler, in which they speedily produce an ebullition of the water, and steam sufficient to drive a miniature engine. By increasing the dimensions of the apparatus, M. Mouchot has obtained a utilizable force, and produced, after three quarters of an hour exposure to the sun, a boiler pressure of 60 lbs. of steam.

NATURAL GAS FURNACES.

The constantly increasing utilization of natural gas for industrial purposes, throughout the oil region of Pennsylvania and its neighborhood, is attracting much favorable comment. The success of the puddling and heating furnaces at Erie, Leechburgh, and elsewhere in Pennsylvania, where the experiment has been thoroughly tried, seems to have attracted a widespread interest to the subject, and we now learn of schemes on foot to utilize the gas upon the large scale. Near Beaver Falls, the gas issuing from a well 1,100 feet deep is employed in a file factory at that place. It is also reported that the product of the great gas well in Butler county, Pa., will be brought to certain iron works in Pittsburgh. The work of laying a pipe, six inches in diameter and seventeen miles long, is said to be contracted for, to be finished within a month. It is further reported that a project is being mooted to purchase all the gas wells in Butler county, and bring their product to the Pittsburgh manufactories. This last scheme, if successfully realized, would work quite an industrial revolution. But, whether feasible or not, the agitation of the subject is an indication that the question, of utilizing the enormous volumes of valuable heating gas which have, until the present, been allowed to go to waste, is at length receiving the attention it deserves.—*American Exchange and Review.*

AN AUTOMATIC SWIMMING APPARATUS.

Under the auspices of the London Swimming Club, and at the City of London Swimming Baths, Golden lane, London, an invention for facilitating the acquisition of the art of swimming was recently exhibited. The invention, which was practically tested in the case of persons who could not swim, first consist in stretching across the bath, in any direction, a wire somewhat similar to a single telegraph wire, placed at some hight above the water and parallel to it. Upon this wire a grooved pulley is mounted, from the axis of which an elastic cord depends, terminating in an adjustable supporting belt for the body to rest on. The weight of the body when in the water is capable of receiving more or less support according to the degree of proficiency the learner has attained. The suspended weight from the axis of the pulley, being under the line of support, keep the pulley in a true vertical position, so that during the time the swimmer is striking out the supporting pulley travels along the wire at a rate proportionate to the speed of the swimmer. To suspend the body in water by a string is not a new idea; but this contrivance is self-acting. The members of the club, who are laudably offering to teach swimming gratuitously to all who lack the art, consider this invention the best that has yet appeared for helping the novice to attain proficiency in swimming.