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HOUSE HEATING.

Historical, Sanitary & Insanitary,

BY

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PRESIDENT'S ADDRESS BEFORE THE ESSEX COUNTY MEDICAL SOCIETY.

REPRINTED FROM "THE SANITARIAN."

HOUSE-HEATING AND ITS DANGERS.

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We are accustomed to speak of the changeable character of a climate, and the variations of temperature, of heat and moisture, of sunshine and cloud, as familiar sources of disease; and it is singular how little we reflect that during the cold months in our climate we are subject to influences of our own making in this matter, of sudden changes of which nature is never guilty.

We go from the heated house or office with temperature at 80° or 90° Fahrenheit, dry and oppressive, into the cold open air at zero, an instantaneous change of the supply to our sensitive lungs of ninety degrees, and this not only once but over and over again; or we inhale the poisoned atmosphere of the lecture room or theatre loaded with moist exhalations, and plunge at once into the dry freezing atmosphere of midwinter; and so common an occurence has it become that we fail to realize the tremendous strain we put upon our organization, much less to look upon it as a removable source of disease and death.

And we even do worse than this: we talk of malarial diseases and blood poisoning, of water contamination and poor ventilation, of infection by impurity of the atmosphere through neglect or ignorance, and then, heating our houses from below, supply the unwholesome air of cellars, or, through a contrivance supposed to be a triumph of hygienic ingenuity called a cold-air box, suck in from the surface of the ground the air we would never breathe willingly, and heat it up to a temperature which will vivify the poisonous germs it may contain and disseminate them through our sleeping rooms. With the powerful draughts from highly heated air in our houses we draw the effluvia of water-closets and drains from the lower levels where they originate, and warming them into activity, we supply them to our families and friends.

It is probably no exaggeration to say that one-half of the diseases of the present day are due to the defective hygiene of modern dwellings and tenements. It would be easy, moreover, to show that this defect is by no means confined to the dwellings of the poor. Indeed, that which has been said is no overdrawn statement of what we are daily encourag-

ing and abetting ; but disease is rarely the immediate or direct result of our own folly—a few days or weeks of incubation are necessary, and it is quite natural that where the occasional purification of a foul atmosphere postpones the poisonous effects, we should, in common with a less thoughtful public, underrate the cause and overlook the danger There is nothing more lamentably true of our human nature, than that we will not appreciate sanitary prophylaxis until disease, or some zealous friend, has proven our folly. A man, for example, will tolerate a noisome stench from a leaky sewer or ill-placed cesspool, even after repeated warnings, till an expensive sickness or more expensive funeral has touched his pocket, or some friend, who has learned the danger by sad experience, has driven him into sanitary reform

One of the most important factors in a safe and healthful architecture is the adaptation of artificial warmth ; and no argument is necessary to show to a thoughtful mind, that it touches the life, the health, and the purse of the community,

The historical part of this matter of house-warming is full of interest.

The refinement and luxury that are the outgrowth of civilization, as we understand the word, scarcely antedate the beginning of the Christian era ; but in looking for the first devices for increasing the comfort of dwellings, we must begin with the migration of the human family to climates where the change of the seasons rendered houses and protecting roofs a necessity. Nomadic races naturally flourish only in climates favorable to a semi-barbarous and houseless life, where the stolen covering of the wild animal, or the simple shelter of rocks and caves suffice to maintain the bodily warmth. It is probable that the primitive man found but little need of anything but mere shelter from wind and rain, and that the first era of house-warming for comfort began with the cave fires of the barbarous races of Asia in their northward journeyings Therefore came the tent, first for shelter, then with a central fire, such as was common with the early Indian races of this continent. Next followed the brazier with glowing coals, so familiar in the pictures and history of ancient Rome ; and later still, the devices for increasing the draught in closed houses, and the inventions for economizing, storing or radiating the heat with which modern history has made us familiar

In searching for the earliest evidences of the introduction of fires into dwellings, we naturally turn to the history of the nations whose magnificence in architecture indicates a corresponding grandeur in all that can, through human device and ingenuity, make life more luxurious and delightful—grand and beautiful their almost imperishable ruins—but of the home life of the people who reared them we can learn almost nothing.

All the vestiges of remote historic periods are, moreover, found in the dry and warm climates lying under tropical skies; and it is not hard to believe that the dwellings, and even the palaces, of these far-off ages, were designed more for shelter and convenience than for luxurious inaction or dissipation. We are, indeed, justified in this belief as regards the inhabitants of Thebes or Nineveh by the fact that even the refined and sensuous patricians of Rome, living under a more changeable climate, and with a far greater appreciation of domestic seclusion and comfort, appear to have paid but little attention to their private dwellings, and to have been content with houses which in modern times would make but uncomfortable prisons. Mr. Layard, in his "Account of Nineveh," says that the private dwellings were probably of but one story in Assyria proper, or Babylonia, and must have been built of perishable materials. Certainly we do not expect to find, and we do not find in the wonderful ruins of Egypt or Asia, the evidences of pride in domestic architecture; temples, altars and treasuries, sepulchres and monuments, gigantic images and marvellous causeways, gates, walls and sculptured stones of curious workmanship, but no firesides; no ruins of homes, even of the rich and great. All—all the crumbling embodiment of a race's consciousness of superior and supernatural power, and a life of which this on earth is but a part.

In farther confirmation of the belief that altars and temples, and not homes, received the chief attention of the ancients, and that all the triumphs of architectural grandeur were expended upon the houses of the gods or the tombs of the kings, we may turn to Peru and Mexico in the days of Spanish conquest; the houses of even the most powerful were mere huts, but the temples were magnificent. As stated by Mr. Barrono: "All the dwellings of ancient Peru, as of ancient China were on the same plan, from the meanest hovel to the viceroy's palace" The walls of Cuzco show the ability to move stones of immense size, and to polish and to fit perfectly blocks even thirty feet in length. The palaces of the Incas had doors with slanting sides like the Egyptians, sloping roofs covered with slabs, or perhaps rushes, and no windows. According to Humboldt, the immense structures among the ruins of Palenque in the Mexican province of Chiapas, discovered in the middle of the last century, of Capan in Honduras, of Labphak and Uxmal in Yucatan, and of Chichen, also in Yucatan, where one of the best preserved buildings appears to have had an altitude of sixty-five feet, with staircases and beautiful sculptured ornaments, had no devices for luxury or comfort of the dwellers in them The rooms are long and narrow, often without windows, and with flat or sometimes arched roofs built in terraces (Stephens' "Incidents of Travel 1842"). The height spoken of by Mr. Stephens,

was probably acquired by terraces, instead of story upon story, as in modern times.

The peculiar one-story plan of all ancient houses, while appearing somewhat singular, may, after all, be due not to any want of desire or ability to do as is now done, but because of earthquakes; for in Mexico and Peru, as in Sicily and Italy and some parts of Asia, there is reason to believe that these convulsions of nature were formerly far more frequent than they are at the present day.

Indeed, the only allusion to dwellings of two stories in remote times that I have been able to find, is the statement of Diodorus Siculus, who says that Busirus supposed to be one of the Pharaohs spoken of in Bible times, built private houses four or five stories high in Thebes or Heliopolis; but no remains confirm such statement, and it is said that. even in his own day, many centuries after the destruction of Thebes, the art of making houses in stories was but little known.

Ancient Hindoo architecture is said to have been similar to the Egyptian.

Ancient New Zealanders are said to have built admirable fortifications, but their houses were extremely poor.

The ruins of old Rome below the streets of the present city. seem to show, by the absence of stairs, that houses were then but one story high ; and the uncovered streets of Pompeii and Herculaneum show the same of those unfortunate cities.

We cannot but be surprised at the indifference of patrician Rome to domestic luxury and refinement. The houses of that day were small and badly constructed, and imperfectly secluded from the public.

The manufacture of glass was familiar, but there seem to have been no windows, as we understand the term; the "fenestra" were mere loopholes for ingress of air ; not a sign of a glazed protection has yet been found. The peculiarities of the ancient dwellings of Italy are still visible, and the courts or cloisters of palaces, monasteries, mansions and inns of to-day are representative of the Cavædia, vestibula, and atria, of Pompeian mansions.

We turn to China to learn of the domestic life of the inhabitants of that most ancient nation ; but far back in the dim ages of its remote antiquity there is nothing to show that the semi-barbarous traits of that period differed materially from those of the present day. There is, however, reason to believe that the climate of China was originally tropical, and that the country enlarged its boundaries and extended northward into the temperate zone; and with the necessities of a more vigorous climate, domestic seclusion and domestic comfort grew into a

semblance of what it is still in the city of Pekin.

The Chinese are even to-day well known for their ignorance of the physical sciences; and their dislike to know more than their ancestors can hardly fail to keep them in a condition far from progressive. Their architecture is still primitive, and their ideas of personal comfort exceedingly crude. I have been much interested in conversing with those who have lived long in China, at the apparently stand-still condition of the race They seem not to have changed for centuries. Missionaries say that there are no evidences whatever that the Chinese as a nation were ever different. From a photograph kindly loaned me by Mr. H. N. Congar, formerly Minister of the United States to China (a picture of the dwelling of a man who thinks his house as grand as it is possible to make it), it seems impossible to believe that one is looking upon a modern dwelling.

When the Chinese are cold they put on additional clothing, and but rarely is artificial heat introduced into the dwelling, for purposes of warmth, and then it is brought in in the chafing-dish or brazier, or what is termed a "Kang," and regarded as a luxury rather than a necessity. Close, narrow, and low-ceiled rooms, outer clothing in abundance, and crowding like rabbits in a burrow, constitute the chief source of extra warmth.

This "Kang" appears to be similar to what was called by the Romans "hypocanstum," a kind of flue under the floor by which the heat of the fire could be carried from room to room, the fire itself being outside; there was, however, no attempt at a chimney, and smoke and gas must, with such a contrivance be more plentiful than warmth. This device is, however, the first attempt, so far as can be found, to do for a dwelling what in modern times is done by the hot-air furnace and its pipes.

As already stated, we must look to the settlement of colder or changeable latitudes for the earliest evidences of house-warming proper, and turn to the nations of Northern Europe; but there is for them no authentic history prior to the tenth century.

Iceland, which has so recently celebrated its millennial anniversary, dates historically back only to the eighth century; and we think it can be shown that long prior to this house-warming was a science in Great Britain. But in these cold countries at the beginning, as it is at the present time, the means of living at all is the great question, with little thought for luxury; and the Icelander and the Esquimaux are fully content to put the furs of the seal or the bear outside, and the fat inside, in sufficient quantity to maintain warmth without the artifi-

cial aid of a fire, for which nature provides no fuel. With them, the brown coal and drift-wood used for culinary purposes are too valuable except for the barest necessity.

As already intimated, the first era of house-warming may be termed that which most closely imitated nature, viz : that of segregation in the caves of the earth, with the skins of wild animals for covering. The second era introduces the fire into the caves, huts of boughs, and tents made of skins. The third brings in the brazier of live coals; and not till the fourth, which introduces the chimney, can the matter of house-warming be considered as a refinement or luxury, or, we might add, as an enemy to health.

This matter of a chimney is, after all, so vital and essential a part of the structure of a modern house, that it is surprising that it was unknown to antiquity, even when we know what we have endeavored to prove, that the dwellings were of such imperfect pattern. But the chimney certainly is a *comparatively* modern invention. We may search in vain for allusion to it, even as late as the beginning of our present Christian era. Vitruvius, the oldest writer upon architecture, who lived probably in the time of Augustus, or perhaps just before, and whose writings are still accessible, gives in his rules for building no directions for chimneys.

Beckman, who appears to be frequently quoted by writers as an authority, says that Julius Polluk collected with great care the Greek names of every part of a dwelling, and that one Grapaldus did the same of Latin terms, but neither of these contained a word expressive of a modern chimney.

The same writer is generally quoted at the present day as authority for the belief that chimneys were not known in England till the time of Elizabeth. But one author, whose name is forgotten, says they were introduced in 1236. They were certainly earlier in Italy, and Octavius Ferrari states that they were in use among the ancients.

In Rochester Castle, as early as 1130, fireplaces were built, and although the flues go up through the wall, with an outlet below the eaves, they were none the less chimneys. It was not, however, till long after this date that they appear to have been at all frequent, and then only in the large halls of houses. In many of the old pictures of the eleventh and twelfth centuries, the central fires appear in the halls, and the smoke was allowed to escape through loop-holes or "louvre."

The "Metropolitan Encyclopædia" says that the earliest reference to chimneys in Italy is in an inscription over a gateway in Venice, which states that in 1347 a great many "fumagouli" were thrown down by an

earthquake; but in a history of Padua, one Francisco de Carrara, Lord of Padua, is said, on a visit to Rome in 1368, to have caused chimneys to be built at his inn similar to those which had been *long* in use in Padua, and therefore probably antedating those alluded to over the Venetian gateway.

But authoritative as these statements have been regarded, they are erroneous. The Romans, who once reared a populous and wealthy city where the London of to-day stands, and in comparison with whose structures the gray old walls are but the work of yesterday, knew probably as much of domestic architecture and its conveniences as we of the present age.

More than fourteen centuries have elapsed since the London of former days was peopled by the conquerors of the world, and the pavement trodden by the Romans lies buried fourteen feet below the streets of the modern city. None of the exhumations of modern times are more replete with interest than those which have within the past twenty years brought to light the coins, pottery, and china, the brass and iron implements, the pavements and sculptures of those forgotten times.

Some of the coins found belonged to the reign of the usurper Allectus, who was slain in the year 297 A D *

For our present inquiry, however, the point of interest lies in the discovery in 1850, in ruins under Sherbourne Lane, and twelve feet below the present pavement, of a pavement twenty feet wide of small bricks laid in mortar; and a wall twelve feet by ten pierced by two flues, one semi-circular and the other rectangular, *the chimneys* undoubtedly of an old mansion. This must have been built before the year 400, for the Romans retired from Britian at about that date.

Roman London could have been no mean city. It must have been opulent and populous, if not magnificent, and furnished a civilization adapted to the changing climate, and which has been the basis of a more modern, but perhaps not more complete refinement than its own.

We may, therefore, be assured that the dates given by authors as those of the beginning of house-heating by the aid of a chimney are incorrect, and fix the time of the introduction of house-fires, even into Great Britian, as early as the fourth century at the least; and the absence of a word in the Latin tongue, which should signify what we call a chimney, loses its importance when we reflect that the language of a people is modified by the necessities of the climate in which they dwell.

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* Knight's History of London.

We may consider the fourth era in the science of house-heating as closed when the chimney had grown into common use to carry off smoke and increase the draught to the fire, and see with what surprising slowness the simple flue developed into a wide and comfortable fireplace with the high stone settles and the formidable screens for shutting off the blasts of air from without, or the heat from the roaring fire within.

It appears that not until the fifteenth century were fireplaces considered essential in the structure of a house; and during all the period intervening between that time and the fourth century, the brazier of coals, the central fire with the rising smoke drawn away through holes near the ceiling, or the constant wearing of outer wraps, were relied upon to meet the changes of the seasons. In the means of escape for smoke, and the windows which were made to allow free ingress of fresh air, consisted the protection against deleterious influences which the air-tight houses of later days did not comprehend. To this closing of the loop-holes and opening of the chimneys is due a long series of changes in domestic architecture, of which those that have sprung from the necessity of adequate ventilation are not the least.

Indeed, it could not fail to be at once apparent, that the regurgitant smoke and the vapors from personal exhalations in closed rooms should affect the health, particularly of the females and younger members of the family who were too closely confined in them.

Variable temperatures, sudden changes, heated heads, and cold feet, close and stifling effluvia from drains and sewers, poisonous gases from ill-contrived furnaces, would give no headaches or debility if we of modern times would look out to the sky through our roofs as did a King of Libya, referred to by Herodotus, who offered the free sunlight of heaven to a servant as a reward, as he pointed to the sun itself, visible through an opening over the fire.

Public sentiment slowly but inevitably arrives at truth after floundering through much of error; and the recent tendency to go back from heaters and stoves to the comfortable fireplaces of the last century is an indication that the former are in some way ill-suited to health or prolongation of life. Fireplaces and generous hearths are said to have been described by Keslar, of Frankfort, in 1614; then by Savot in 1625, by Delesme in 1686, and by Cardinal de Polignac in 1715. Then came Franklin in 1774, and Count Rumford in 1796: the latter writer being familiar for his researches, experiments and contrivances for warming and ventilating public and private houses—as famous in his day as Arnott and Reid and a score of others of later times.

For more than two centuries these luxuries were enjoyed only by the wealthy; and it is, perhaps, only to the necessity for economy of fuel that stoves and furnaces owe their origin. Certain it is, that a properly comfortable fireplace requires an extravagant supply of fuel, and that the waste of heat is enormous

There can perhaps be no better opportunity to allude to the possible hygienic objections to this method of heating and their correction.

It is interesting to note that the device has always been considered a luxury. The glowing coals, the roaring fire, the wide and attractive hearth, possess a charm which few can fail to feel.

But it is surprising that the tax collector should levy upon it as a source of revenue. In the time of Charles II. such a tax was levied, and termed chimney money. This was, however, abolished in the reign of William and Mary.

With a plentiful supply of wood, it is perhaps safe to assume that no valid objection could arise, on sanitary grounds; for the lower stratum of air in the room could be well heated, draughts could be modified or avoided by supply-pipes passing under the floors to the hearth, or better and more simply by providing openings under the cornices ("Encyclop. Metrop."). But, unfortunately the supply of wood even in this country is becoming limited, and the fireplace is rapidly becoming a chimney place with a grate for coal. To this the objection that may arise is the frequent presence of irritating dust and ashes, or, when the chimney-breast is badly constructed, the escape of carbonic acid gas. That this is no imaginary evil, I have been satisfied from observation in a sitting-room, 23 x 12 feet, where the grate was set apparently upon correct principles but where the odor of gas was clearly preceptible.

The defect is due in such instances generally to the shape of the chimney-throat, it being necessary to narrow this just above the fire to prevent the downward passage of a cool current — a not-uncommon occurence when the flue is generously large. When this detect is very great, smoke as well as gas is frequently forced out into the room.

Another source of gas and smoke, (and we speak now of fire-grates chiefly,) is one often quite mysterious, that can occur only in houses which are illy supplied with outside air, but it is one which would be found far more frequently if attempts were made to warm many rooms in the same house, and would be particularly productive of injury if sleeping-rooms were to be kept warm by such fires. This is where two fireplaces exist in the same chimney in parallel flues, the one on an upper floor, and the other on a lower. We will suppose that the one in the upper room with the doors open, and the one in a lower, with win-

dow closed, as is often the custom at night, the coolness of the upper as compared with the lower will diminish its draught in proportion to the difference of temperature produced by the fires in the flues, and the one in the upper will speedily go out, the vapors and gases falling to the floor and tending to flow out into the hall and down-stairs in the direction of the fire on the lower floor. The reverse will be the case if the lower fire becomes faint, or is allowed to expire; although the former is the more common, as the longer flue is more likely to maintain its fire in activity.

This defect will often result in the morning headache and furred tongue, with languor, so commonly observed even among the better classes, where double windows and weather-strips convert the house into an air-tight box, and like many other defects can only be remedied by proper ventilation.

The same danger of the escape of carbonic acid from an open fire is enhanced where sleeping-rooms are thus warmed, from the circumstance that after the earth's surface at night has ceased to radiate the heat received during the day, the currents of air, which, when warm, continually rise and assist the hotter currents coming from the chimney-flue, cease to rise, the fire in the grate goes down, and the flue becomes cooler and cooler till a sluggish column accumulates in the upper part of the chimney, and the draught is destroyed. From the time that the fire lost its activity to this point, the carbonic acid had ceased to be converted into carbonic oxide, and, no longer sufficiently heated to rise, has begun to spread out over the floor. When the draught is entirely arrested, this process is somewhat increased so long as any combustion goes on, and if the room is closed, and the fireplace alone relied upon for ventilation, the vitiated air is still farther vitiated by this source of supply.

It is hardly possible that fireplaces, however desirable, can ever become so popular as to be relied upon to the exclusion of other means of heating, not only because of the extravagance implied, and the great waste of heat involved, but because the fires can with difficulty be made to keep the temperature equable, and, where only the principal rooms would be heated, the discomfort of cold halls and stairways and small rooms would be too annoying to be endured.

One other, and by no means light, objection to the fireplace, is the floor-draught already alluded to. We often find ladies complaining of "influenza" where no other possible source of cold can be chargeable with the difficulty other than reading before one of these fires till the feet and limbs, or perhaps the back of the neck, has become chilled. This

is now frequently remedied by an aperture below the grate floor or hearth-stone, through which the necessary supply of air is maintained for the fire.

With one other and practical remark about the popular fallacy that an open fireplace *without a fire* is a good ventilator for a sleeping-room, we will leave this part of the subject. Nothing is more common than to see a fireplace left open for this purpose. A moment's reflection will, however, show that this is of no avail unless the chimney be hot by conduction from some one of the other flues, or the flue itself be heated. On the other hand, it does not supply a downward stream of *cold air*, as some suppose, unless the room be very warm, and *some outlet* exist near the ceiling by which a current may be established; but if the fireplace itself were high up, or, better still, closed, and an opening made in the chimney under the cornice, then an upward and ventilating draught would be established. Five minutes' experiment with a lighted taper or a feather will confirm this assertion. The column of air in such chimneys is almost entirely stationary, and can certainly not be a means of carrying off the vitiated products of respiration, since these are heavier than air, and fall, unless heated, instead of rising. Even when the chimney is heated and an upward draught produced, I have known the air of the bed-room excessively foul where the bed was standing, simply because a window on the opposite side of the room supplied its stream of cold air which descended by the wall, passed under the bed, and so to the fireplace, leaving the bed high and dry, as it were, in the stagnant and impure air.

The existence of carbonic acid in our houses, whether as a result of respiration or of ordinary combustion, is so often spoken of and is so important that a popular error regarding it should be corrected. It is, for example, a familiar fact that this gas when pure descends and displaces the lower stratum of air. Now this is only to a certain extent true in our houses, since carbonic acid does not remain clear, but mixes immediately with surrounding air. So long as the admixture is not excessive, the tendency is *to rise* rather than fall under the influence of heat, and only when in excess of cold does it descend.

When in the proportion of 1 part to 2,000 it is stimulating, when 1 part in 100 it becomes poisonous, and when as many as 10 parts exist in 100 it is speedily fatal; although where the contamination is gradual the system is rendered somewhat tolerant of its presence. This property, however, which it possesses, of rising under the influence of heat, is one which chiefly concerns our present subject and without a knowledge of which proper ventilation is impossible.

Floor draughts, unequal temperature, inadequate ventilation, and carbonic acid, constitute almost the whole sources of danger to health in the somewhat primitive methods of house-warming by open fires; but the advances made during the nineteenth century in domestic architecure have added other sources of injury which have been increased by the introduction of stoves and central heaters. What has taken place historically in the large cities of the world in this respect may be observed as still occurring in the western part of our own country. The open fires gradually yield before the more economical wood-burning stoves; next follows the small-coal burner with its original defects; then the more complicated contrivances for obviating the most glaring and unbearable of these defects; and slowly but steadily, the furnace or the steam-heater, or the hot-water circulating coils. In the South and extreme West the open fire still holds pre-eminence. Several months since, having occasion in connection with several others to collect statistical material on sanitary subjects, circulars were addressed to the prominent physicians in different counties of almost every State of the Union. In these we took occasion to ask concerning the subject of household fires and the diseases likely to grow out of the different customs.

The prevalence of bronchial and general catarrhal difficulties was noticeable, and these in many instances were attributed to defective methods of house-warming.

In Indiana, the air-tight coal stove appears to be coming into use where open fires have prevailed, and a great increase of throat difficulty, lung disease, and loss of vigor in children, is ascribed to them. In Ohio, open fires of wood and bituminous coal are still almost universal, but in and near the cities the introduction of stoves and furnaces is spoken of and deplored.

In Illinois and Western Pennsylvania, the use of fires in tightly-closed and ill-ventilated apartments is spoken of as a source of disease. Indeed, throught the West, the same testimony is given, and several express their belief that Eastern diseases are moving westward with the progress of the forcing hot-house principle.

One of the most striking commentaries on the misfortunes that attend the growth of modern ideas of comfort in this matter of heat is, that in all favored health resorts improvement is rapid and cures are marvellous, while all is crude, and rough, and free; but with the income of new and wealthy patrons, new necessities for ease and luxury come up, and when the huts give place to inns, and inns to costly and comfortable hotels, all is changed. The very principle of vitality is cut off, and the invalid with his cosey fire and soft carpet and double windows shuts off

for himself the avenues to recovery This observation is becoming a familiar one, and shut our eyes to it or not, it is none the less true that to rough it a little, and to feel the cold and breathe the air keen and fresh as the frosts of a beneficent Creator have made it, is better than to stagnate in an excessive and enervating heat.

The consumptive who dares the exposure of the woods in his narrow tent and returns to the primitive freedom for which man was designed, is the one who improves, while his wealthier brother groans and growls over a poor but costly table, or shivers in a room heated to summer heat, but chilling with the dampness of an exhausted air, speedily succumbs.

We may here perhaps best speak of this singular chilliness of an atmosphere which has been breathed over and over until exhausted. One may at any time by a visit to some of our factories, find men sitting at their work in a damp-warm atmosphere with the thermometer at 70°, and complaining of the cold. The atmosphere is close and foul, the chilliness causes the men to shut the closed windows or doors still tighter, and the actual heat may rise to 80°, without much warmth. This is often true in furnace-heated houses, but it will always be found that there is no ventilation. The air is saturated with moisture, and the conduction of the natural bodily warmth is rapid and constant. The addition of the fire and the actual increase of the temperature of the room fails to obviate this, since it is an established fact that the heat does not dry the air, but increases its capacity for holding water in suspension. But to return:

The inimical relation of devices for personal comfort to health cannot be better shown than by a remarkable tract of land known as the Cumberland plateau in Tennessee. It is thirty miles long, and, I think, five or six miles wide; and with six thousand inhabitants has never known a case of consumption. Dr. E. M. Wight, of Memphis, attemped a study of the region, and the problem was soon solved. The inhabitants were farmers, primitive to the last degree, almost devoid of what we call luxury They worked, and ate, and slept, regardless of the world around them. Their houses were windowless, and often doorless; shelter only was all that was sought, and neither consumption nor any other disease found foothold among them. The introduction of a first-class hotel whould have broken the spell, and it wlll probably never be tried.

The closing era of house-warming is the one in which the idea of a central fire predominates. The hot-air furnace finds its prototype in what was formerly known as the cockle stove, invented by Mr Strutt, and originally designed to prevent the overheating of air, a virtue entire-

ly omitted in its later and larger development.

This contrivance, which in its relation to health may be termed infernal, is usually placed in the cellar, and being often only an iron stove surrounded with a casing, draws its supply of air from the cellar bottom, where the dust from the fire is shaken out in greatest abundance. This air, entering the casing from below, is heated and carried upward through pipes to different parts of the house.

We have already said that improvements in house-building introduced new sources of danger in connection with heat, and one of these is the sewer drain. Frequently leaking, even when not inside the house, the poisonous vapors find their way through walls and the surface of the earth just where another enemy in disguise, termed the cold-air box, stands open. The half dormant germs of disease pass in across the heated surface; if it is red hot they are destroyed, and the products of their decomposition are carried up by a stream of air burned of its oxygen to the house. If the iron is not red-hot the germs are vivified and carried up to be planted in our circulation through the lungs. Sulphuretted, carburetted and phosphoretted hydrogen, in the one case (for red-hot iron permits the transpiration of the gases of combustion), and in the other fevers, bronchitis, headache, and diarrhœa

It is absurd to say that the colds and influenzas and so-called malarial diseases, which periodically occur with the building of the winter fires, are accidental. Why are the zymotic diseases so prevalent in the cold months? Is it not because these germs are heated, and nursed, and coaxed into life by our own stupidity?

Would we willingly sleep on the cellar floor or on the ground just under the kitchen window? And yet with a supply of air night and day from these sources made more dangerous by heating, we rest content.

Sanitary science is only now showing signs of profitable vitality, and already the heating apparatus by hot water or by steam is proving its superiority over the cheaper but dangerous hot-air furnace. Still these are too expensive for the masses, and the sources of supply of the air to be heated may be as bad in the one case as in the other.

Good ideas are slow in finding entrance to the public mind, and perhaps some of the simple hot-water coils and heaters may yet be adapted to the meanest house. The idea of a source of central supply, not as regards a house, but a whole city, is just now receiving attention in New York, and capital is forthcoming to make it a reality, although the suggestion was made public and fully elaborated in the *Quarterly Review* in 1866. This plan of supplying hot water or steam to a whole city in the same manner as gas, is so plausible that in Berlin a portion of the city has

been recently set off for a trial, and subscriptions to the amount of several millions have been paid in. It certainly seems feasible, and can hardly be expensive to individual subscribers. If this ever comes to be an accomplished fact, ventilation will be simplified, and many of our diseases will disappear, and particularly would the terrible rate of infant mortality in cities be diminished.

The great requisite in correcting the evils from our present systems of heating, is a free supply of fresh air and a perfectly regular means of exit for that which has once been respired. One ingenious and sanguine writer recently suggested that in all streets in cities and towns a single chimney be employed for each street, and be placed over the sewer. To this all pipes from individual houses were to be conducted; and inasmuch as, summer and winter, an upward draught would be maintained, while the products of combustion were being carried off, no sewer gas could be sucked in, since that, too, would be carried up and away.

A simple device which would add but little to the cost of every house when being built, and which would furnish a supply of air always sweet and pure, would be to have for every fire chimney a supplementary one in the opposite wall. Connecting this at its base with the hot-air boxes or steam coils, or even the furnace, would create a down draught in the cold chimney which would give the pure, clear air of the atmosphere at a high level

It is useless to raise our voices against an evil unless we can supply a remedy; but inasmuch as house-heating is a necessity, and all the modern means that are available are somewhat defective, we can at least choose the least of the evils, and surely rather than have a hot-air furnace, better return to separate fires in modern stoves, or to the extravagance of the fireplace, unless the present defects, and particularly those relating to supply of pure air to be heated, can be remedied by better ventilation.

Briefly to summarize both the sources of disease and the diseases likely to arise from artificial heating, we have :

1. Vitiated air in sleeping rooms made thus, and deleterious, through carbonic acid, or the sulphuretted or phosphoretted gases, transpired through overheated iron, producing the morning headache, lassitude and constipation, or the more serious disorders of the stomach, liver or skin.

2. Poison germs from unclean cellars, or leaking drains, or of surface air from outside warmed into life and developing diphtheria, typhoid and typho-malarial fevers, infantile diarrhœas, or the wasting disorders of early childhood, erysipelas. puerperal fever, and other diseases arising from blood-poisoning.

3 High or suddenly changed temperatures, re-breathing of air in close-shut rooms—producing influenza, catarrh, bronchitis and consumption.