

HISTORY AND HYGIENE OF LINEN.

BY HARRY C. O'NEILL.

I. Its History.

BACK in the City of Thebes, once called the Egyptian Taape, the remnant of the Invading Arab glides from his hut, out over the ruins of the ancient houses, and leads you to many and varied antiquities. But this child of Fellaheen can astonish the general man, if persuasion be strong and the fee sufficient to procure from some of the tombs pieces of washable linen, woven at least three thousand years ago. Although this is as old as he may be able to find, capable of standing washing, yet there remains pieces of the fabric made in the time of Annos or Onnos in the 5th dynasty or about 3,400 years B. C. These are the care cloths with which the mummies are wrapped, and when originally used, were dipped in oil and bitumen and prepared according to the secrets which give to olden times the prestige in embalming. And here your Arab friend would probably drop his voice and mysteriously tell you of the faith of these Children of the Past, of the transmigration of the soul and of their belief that the body must be wrapped in linen to cleanse it when the subject should be called to the Court of the Sun.

How far back this recognition of the cleanliness of linen extended we are unable to say, for the origin and invention of it is hidden in the dim, hazy existence of the earlier world, out of which it has come with man, serving for him, as it were, an outer skin for the protection from the elements in health and as soothing bandages when the body was sick and sore.

The Bible and the Talmud both refer frequently to the use of linen and we find it in the garments of the priests of the Palestine Temples. Moses commanded the priests to use linen, and

many authorities maintain that linen threads comprise the famous cloth with which Veronica wiped the sweat from the brow of Christ on His way to the cross.

In those halcyon days of the race everybody wore linen. After the primitive fig leaf and the skins of animals, linen was almost the universal garment of the race for many generations. The Bible is full of allusions to flax and linen, and as early as the exodus, where we find Aaron and his sons set apart and dedicated to the priesthood, their costumes and paraphernalia are described minutely, and among other things the costumers are commanded to make holy garments for glory and for beauty, of gold and blue and purple and scarlet and fine linen. The ephod should be of fine twined linen, with cunning work, and the curious girdle was to be of the same. Those were to be an embroidered coat of fine linen, and the priests were to have linen breeches to cover their nakedness.

In Leviticus we are told that the priest shall put on his linen garment and his linen breeches. Ezekiel xliv, 17-18, reads: "They shall be clothed with linen garments and no wool shall come upon them . . . they shall not gird themselves with anything that causes sweat."

Samuel ministered before the Lord in linen, and he tells us that on a certain day Doeg "slew fourscore and five persons that did not wear a linen ephod," and St. John says he saw seven angels coming out of the temple clothed in pure white linen.

Until the dark ages, the use of linen was apace with civilization, but in these trying times of the Learned World, it seems as if its scarcity increased its value too much for common use. It was however, preserved through this period

by the churches in the use of altar cloths and vestments, and ere the Ship of Human Progress had set full sail, it was reinstated in the wardrobe of all intelligent persons.

So common was linen apparel in England in 1357 that a statute was passed declaring that laborers in husbandry should only wear a blanket and russet and girdle of linen. And if, as Swedenborg tells us, human garments denote states of wisdom, and are, therefore, much spoken of in the Bible, then linen should be the garb of all wise men.

Gradually the demand far exceeded the supply, for though flax grows wild in Persia, that quality of fibre which is suitable for linen, is the result of only careful cultivation in the countries of Russia, Belgium, Germany and Ireland. Considerable labor, as well as skill, is needed in the raising of flax, and it is for this reason that America, using more of this cloth than any other country in the world, is forced to buy almost her entire supply from foreign countries, her linen imports averaging \$30,000,000 annually. Recent investigations and experiments have created quite a favorable impression for the northern part of the Pacific Coast as a flax raising country. At the present time, flax is raised by thousands of tons in this country, but it is for seed only, and the fibre cannot be used. Flax for fibre must be grown tall and slender, while for seed a low, bushy growth is desirable.

It will take some years of education and experience, however, before fibre flax raising can be put on a good footing, for the care of the plant from the seed to the yarn, is no ordinary work.

First, it can only be grown in a locality where the air is moist and no severe wind or rain storms play havoc with the crop between the months of May and August. The temperature should be from 50 to 60 degrees, and the humidity from 65 to 78 per cent.

Flax should not be returned to the same soil before the lapse of at least five years in order to allow the earth to enrich itself and throw off any tendency to weeds by a rotation in crops.

The fibre is of such delicate organism that too great care cannot be taken of it, and in some parts of Europe, where the soil seems to be infested with wild growth, persons weed by hand at stated intervals.

When in bloom, one cannot desire a prettier sight than a field of flax. The stalk, a beautiful, fresh, soft green, is topped off with a little blossom of what might be called a deep shade of pale blue. The blending of the two colors is exquisite to lovers of nature, and the plant is so tender that every zephyr sends a motion over the entire field, which well calls forth the expression, "A sea of blossom."

The crop is ready to be pulled when the stalk commences to turn yellow at the ground.

The roots are generally taken out with the stalk and freed from dirt by being hit against the boot. The stalk ends are tied together in bundles and taken to some body of water to be "retted."

"Retting" consists in covering the flax with water, allowing it to ferment, so that the coarser or outside fibre may be more easily separated from the finer inside. It was done in the past in the ponds and streams, where the flax was kept under water by means of stones and weights, not allowing it, however, to touch the bottom. It took some weeks to gain the desired result by this means and the stench was almost unbearable when the flax was finally removed. Science has invented tanks and other contrivances by which retting may be done in a much shorter space of time, but many parts of Europe still hold to the old custom.

After retting, the stalk is broken, a process which is greatly facilitated by the retting. When the inside or finer fibre is separated from the outside one, the former is sent to be "scutched," which is really the combing of the fibre and the segregating of the good long ones from the small and least useful, which latter are used for tow. The flax is then ready to be spun.

In olden times, spinning was done on a contrivance called a spindle, which, however, was but the crude principle of



New Zealand flax, showing fibre.

the spinning wheel, to which it gave way in the 16th century.

As early as the seventeenth century, Germany established spinning schools, where girls were taught the art which was fast becoming one of the important industries of the day. In fact, it soon became so popular that every house had its spinning chamber, or "Spinn Stube," where the neighboring young maidens would congregate once a week, taking along their spinning wheels and passing the time with spinning their yarn and discussing the events of the day. About ten o'clock the young men would appear upon the scene to offer themselves as escorts after merrymaking and jest had been indulged in, and many a wheel, as it turned on and spun its yarn, winked slyly to its neighbor at the words of love some youth poured into a blushing maiden's ear.

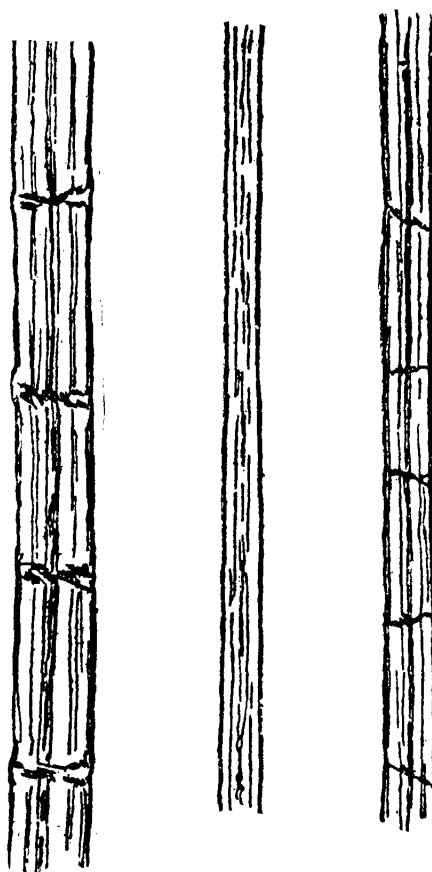
Out of that sphere has come to us the story of Marguerite, the maiden whose lover has followed the fortunes of war. While others make merry, she sits aside, silently spins her yarn, dreaming of the past, she turns over and over again her plans for the future, calling up her fears and excuses that no letter nor word has come from him, and so drifts on in hope.

The old spinning wheel is still used in many parts, and the finest cambric of to-day is still made from hand-spun yarn.

However, when Arkwright invented his cotton spinning device, the attention of linen spinners was called to the possibilities of spinning flax likewise. It was 1812, however, before the first power spinning of linen was started in London, but the cheapness of cotton manufacture, and the lax attention to flax raising had already done considerable harm to the better cloth.

Damascus continued her ancient art of weaving figured linen damask, Cambrai her fine cambric and Ireland the finest linen in the world, but universal attention was hypnotized with the possibilities of the substitution of cotton.

But after a trial, this latter fabric was found wanting for inner wear and for

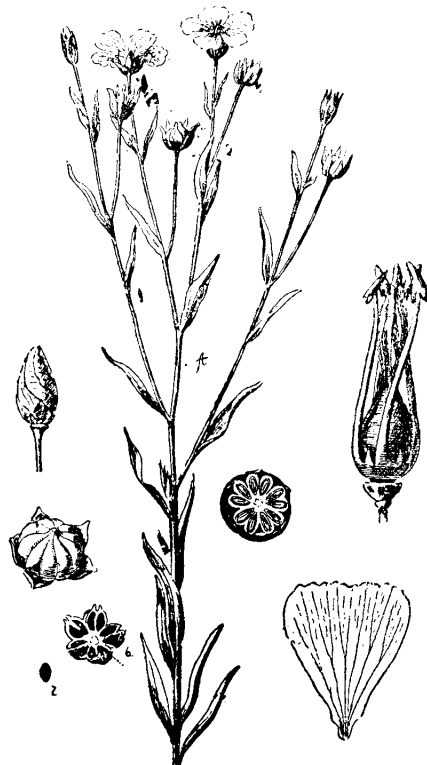


Flax fibre.

general body use, and instead of turning back to linen, wool was heralded far and wide for body wear. It is only for about the last fifty years that civilization has permitted wool to come in close contact with the skin, and even then in special treatment, such as in cases of sores and burns, linen is still called upon.

Wool as an outer garment was worn, and knitted woolen vests were used previous to this time, but linen was invariably put under the wool to keep it from coming in touch with the skin. In Shakespeare we find such quotations as "I go woolward for penance," and "They enjoined him in Rome for want of linen."

Voltaire must have recognized the terrible results of the ignorance of linen,



Flax plant.

for he cries out, "Want of linen was the cause of all diseases known as leprosy."

The wearing of linen collars and cuffs is but the relic of an old custom, a custom followed in a way by Charlemagne and the Normans who wore nothing but linen next to the skin and used only that fabric for cloth which came in close contact with the body. As circumstances and customs changed the style, but not the material, the linen shirt of our forefathers gradually worked itself into universal use. The garment was finished at the wrists and neck with cuffs and collar, and at the throat was attached a lap, over which the vest buttoned. Are not our linen cuffs and collars a relic of this ancient custom?

Another point by which linen retains its supremacy is that it can be boiled in washing, and any cloth coming in close touch with the skin should be frequently washed in extremely hot

water or boiled in order to remove any poisons which may have escaped from the body.

An attempt was made to deprive linen of one of its main callings by the introduction of the woolen handkerchief, but a prevalence of sore and irritated noses followed, and it soon took flight. Thus was linen's soothing and healthful qualities demonstrated; but many failed to realize that the mucous membrane of the nose is but the continuation of the outside skin, a little more sensitive on account of its function probably, but still of the same general composition.

II. Its Hygiene.

Life is productive of heat. The chemical changes going on in an average human body under normal conditions produce within 24 hours a sufficient amount of heat to raise sixty pints of water from the freezing to the boiling point.

Our body has to maintain an even temperature, which is about $98\frac{1}{2}$ degrees F., hence it has to eliminate whatever heat it produces. A complete retention of the heat generated in the body would cause death within a few hours, while a partial interference with its elimination will cause considerable disturbance of health, the severity of which disturbance will be in accordance with the amount of heat retained.

Our body loses its heat by radiation, evaporation and conduction.

The average loss of heat by radiation amounts to more than 50 per cent of all the heat loss by radiation. Whenever the object surrounding our body, be it air or clothing, ceases to be cooler, as, for instance, in excessive summer heat, radiation will cease, and an increased evaporation will take its place, as shown by perspiration.

Evaporation is favored by dryness and impaired by humidity. While we can stand an amount of dry heat, exceeding that of our body by 50 degrees or more, for some length of time, we must inevitably perish if our body should be exposed to the same amount of moist heat.

It is well known to all of us that in a dry climate excessive heat is much less

felt than in a moist one.

Transplant the summer heat of the interior of California or Arizona to New York, and the reports of death from over-heating will be alarming.

Conduction is the third agent for the disposal of our heat. It is favored by a velocity of the air current as well as by moisture. If you moisten a finger and hold it up in the air, it will feel the cold much more than a dry finger held in the same way. If you should now open the door and window and thereby cause a rapid current of air, commonly called a draught, the conduction of heat will be greatly increased, and you will even be able to tell in which direction the current travels. Hence we feel excessive cold the same as excessive heat much more in a moist than in a dry climate.

The temperature of the surrounding air, its degree of humidity, as well as its velocity, are subject to frequent and considerable changes. While our body has at its command defensive weapons of its own to meet the extremes of climate and season, we resort principally to clothing as the most efficient means of protection. While it is the aim and purpose of our clothing to surround our body with a climate less severe and less subject to variations than the one which nature has provided, our clothing should at the same time be so constructed and of such material as will not interfere with a uniform elimination of that amount of heat of which our body has to dispose.

The protective feature of clothing depends upon its air-holding capacity or porosity. A calm layer of air is the poorest conductor of heat, hence the air held within the meshes of a porous garment will prevent the rapid loss of heat, caused by plain and smooth fabrics.

A loosely knitted shawl will keep much warmer than a smooth one containing the same amount of wool.

It is for this reason that, although the fibre of wool and the fibre of flax show no difference so far as the property of conducting heat is concerned, a porous woollen garment will keep the body

much warmer than one made of plain and smooth linen, but offers no better protection against the loss of heat by radiation than a porous linen garment of the same air-holding capacity.

The second provision for the elimination of heat is by evaporation. Under normal conditions our body loses through the skin from two to three pints of moisture in the form of evaporation during 24 hours. Since humidity does not favor evaporation, it is important that whatever vapor or water is excreted by the skin should not alone be taken up by such material as we may place next to our skin, but should also be given off or eliminated. Our skin, as well as the air and clothes surrounding it should be dry.

The property of absorbing and eliminating moisture differs greatly in various fabrics used for underclothing. All authorities on matters of hygiene agree that the absorption as well as the elimination of moisture takes place proportionately quicker with linen than with wool, cotton or silk.

The defect of wool in the power of quickly absorbing and eliminating moisture is a serious one, and if properly understood would do away with its use for underclothing. A woollen undergarment, when first put on the dry body, will impart to the same a feeling of warmth and comfort, which will continue as long as the evaporation of the skin is not in excess of the ability of the wool to absorb and eliminate the moisture. However, if the consequences of impaired radiation of heat, as by physical exertion, evaporation should be increased, wool will no longer be able to absorb the moisture as fast as excreted from the skin, nor will it be able to part with all it may absorb, hence the skin and the air surrounding it, as well as the garment itself will be moist, and a further evaporation will be greatly interfered with. The feeling of oppression which the body experiences under such conditions, and which is due to the retention of heat, those who wear wool next to the skin are best qualified to describe.

As observed before, moisture and velocity of air augment the conduction of

heat. If the wet body should under the above conditions be exposed to a draught a rapid abstraction of heat would at once take place, which would chill the body, and which usually results in a cold. It is a matter of daily observation that all those who wear wool next to the skin are very prone to contract colds.

A porous linen, having the advantage over all other fabrics of absorbing moisture and eliminating it quickly, will provide for a dry climate around our body, hence will enable us to stand extremes of heat and extremes of cold with comparative comfort. Having further the property of cleanliness and being non-irritating to the skin, it would seem peculiar that its advantage for the purpose of underclothing should not have been recognized until recently.

However, it is a fact that it is the oldest material for skin wear in exist-

ence. Wherever we may search in the records of time gone by, we find evidences of the use of linen underwear. In Greece, in Egypt, in India, the art of weaving fine, as well as porous, linen, was well known.

If linen has for a few decades given way to woolen and cotton underwear, it has been due to the difficulty of manufacturing of flax a uniformly porous fabric. While, from the elastic wool and cotton, hosiery textures could be woven, manufacturers of linen confine themselves to the looms of warp and weft, producing only a plain and smooth fabric of little porosity and entirely wanting in elasticity. It is but recently that this defect has been overcome. A method has been found by which the flax fibre can be woven into a highly satisfactory fabric of uniform porosity and pliability, complying with every hygienic requirement.

THE FOUNDER OF LINEN MESH.

SOME twelve years ago a Denver physician came to Southern California in quest of health. Super-vening an attack of surgical blood poisoning, Bright's disease, that insidious destroyer of so many promising lives, had taken hold of him. Finding no relief after two months' sojourn in the city of Santa Barbara, he repaired to a little mountain resort situated in a sheltered nook in one of the picturesque canyons of the Santa Inez Range, known as the Montecito Hot Springs, hoping that the healing mineral waters coming direct from nature's laboratory, might be helpful to him.

Being the only guest at this hidden-away place, what wonder that the balmy air, so free from the chilling fogs of the valley, tempted him to bask in the sunshine for hours after his bath in the pool, filled to overflowing with the velvety sulphur water springing out of the crevices of huge mountain boulders!

Experiencing in this way a delightful sense of freedom and contentment he

came to spend many an hour on the brink of the springs with no covering other than a towel about him.

Whether fact or fancy it seemed to him that resuming the garb of civilization was usually followed by a feeling of distress and nervous irritability so well known to him as the concomitants attending his illness, and caused by the failure of the excretory organs to effectually rid the system of the poisonous products of waste. Bent on solving the question, which the inexorable sphinx had propounded to him so early in life in the guise of disease, to be answered correctly under pain of death, he spent many a lonesome hour endeavoring to solve the riddle, why the signs of recovery, manifesting themselves so plainly when clad in the garb of nature, should vanish on donning the garments which science had proclaimed were for the purpose of protecting his body against the dangers of exposure. Could science be in error? Might his garments be interfering with the activity of the



Dr. Deimel, discoverer of linen mesh.

skin, so vital to him in his efforts to regain his health? And if so, would not the Springs, effectual as they might be in arousing his skin to increased activity, be but of momentary help to him?

One day while experimenting with the garment which he wore next to the skin, and which was of woolen texture, he observed that tiny drops of dew would collect upon its surface when exposed to the vapor arising from the springs. Unable to pass through or even into the wool, the vapor had evidently condensed into drops, gathering upon the filaments of the garment. Subjecting a linen towel to the same test, it was observed that the vapor found no hindrance in its onward passage into the outer air.

This little experiment recalled to him the days of his boyhood when following the custom of the time he wore linen shirts of coarse homespun texture next to his body, even in winter, when wading through the snow up to his waist and when suffering and sickness were strangers to him. "A kingdom for the happy days of youth and health."

Not long after he found himself clad in undergarments made of coarse linen, and in spite of the grave prognosis of his medical brethren, who had examined

him during his illness, he regained his health completely and resumed the practice of his profession, locating in Santa Barbara.

This is, in short, the first inception of a business enterprise which to-day extends its branches and ramifications around the globe, which affords employment to a thousand men and women and which gives comfort and health to millions.

In the practice of his profession, Dr. Deimel had a fruitful opportunity of testing the scope of his personal experience in the matter of proper garments for the skin. At first he did so tentatively, not being sure whether his own case would permit of general application, yet such was the unfailing result for good on the part of all who exchanged their flannels for linen undergarments, that he could not escape the conviction that the modern method of wearing woollens next to the skin was answerable for a host of ailments, lowering vitality and in many instances shortening life, while linen, the garb of our forefathers, would restore even the most weakened skin to a condition of robust activity and impart vigor to the whole system.

Once, at the bedside of a patient suffering from acute rheumatism, attended by high fever, his little experiment at the Hot Springs was vividly recalled to his mind. In examining the patient he found the inner surface of the flannel shirt covered with tiny drops of perspiration like dew on Gideon's fleece. Had not his experiment repeated itself in this instance? Had not the vapory exhalations of the pores meeting the obstructing influence of the woolen garment condensed into drops to be brought back into contact with the patient's fever-heated skin? What could nature's efforts avail, even aided by medical science, if the impurities thrown upon the skin would meet with such obstruction in their outward passage?

Linen garments, changed afresh morning and evening brought recovery in the course of a few weeks from an attack, which, according to previous experience should have lasted as many months.

In pursuing his studies the Doctor was

often surprised at the many references recorded throughout the literature of ancient and less remote times in favor of linen for underwear. Among the most striking quotations a passage from Shakespeare is worthy of record:

"I go woolward for penance."

"True, and it was enjoined him in Rome for want of linen."—*Love's Labor Lost*, Act V., Scene II.

Could the discomfort of wool next to the body and the sanitary features of linen be stated more tersely?

With the spreading of the linen underwear gospel a difficulty presented itself in obtaining a supply of suitable linen undergarments. The linen cloth purchased by the yard and made into garments was woven too close and fine without any regard to porosity, and would often impart a sensation of chilliness. In order to obtain a material which in every way would meet the requirements of a severe and changeable climate, Dr. De-

mel undertook, in the summer of 1894, a journey to Europe in order to study the technical points involved in the manufacture of linen, bringing home with him a fabric which since then has been so ably exploited by the Deimel Linen-Mesh Company, and which has become famous the world over for the healthfulness and comfort which it imparts to the wearers.

The success of this enterprise, which dates its origin back to a little mountain health resort in Southern California, may be gauged by the fact that a thousand of the best houses throughout the world sell the Dr. Deimel Underwear to an appreciative public, and that the branches of the company conducted under the direct supervision of Dr. Demiel include spinning and weaving mills in Duren, Germany, factories, wholesale and retail stores in London, New York, Brooklyn, Montreal, Washington, D. C., and last, but not least, San Francisco.
