

OBSERVATIONS AND EXPERIMENTS

ON THE TREATMENT OF INJURIES OCCASIONED BY FIRE AND HEATED SUBSTANCES.

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THE application of substances to the human fibre, which are heated beyond a certain temperature, is followed by the phenomena of pain and inflammation. The pain is of a peculiar kind, resembling that from the continued application of fire to the part ; the inflammation has an uncommon tendency to suppurate, in which event it generally leaves a contracted cicatrix.

The communication of an excessive quantity of caloric to animal bodies, whether living or dead, is followed by certain changes. Of the fluids some are coagulated, others are decomposed, or even vaporized, if the heat be sufficient. The solids are in a greater or less degree expanded, disorganized or decomposed ; according to their susceptibility of change and the quantity of caloric received. These processes in the living body being incompatible with its healthy condition, a morbid state of the part affected necessarily ensues. This state is marked by pain, redness, swelling, vesication, suppuration, or mortification ; according to the degree and extent of the injury suffered.

The distressing effects of these injuries, when they exist in an extensive degree, are exceeded by few diseases. Very dangerous cases often occur in children, whose clothes are accidentally kindled ; in intoxicated persons, who fall into the fire ; and in those exposed by conflagrations, or by explosions of gunpowder and the inflammable gases of mines. The peculiar appearance of a burnt surface has commonly been supposed to require a peculiar treatment ; and many practitioners, instead of resorting to the general remedies of inflammation, have placed their reliance on the supposed powers of a specific remedy. In this way different and opposite modes of treatment have been adopted, whose apparent success or failure at different times has occasioned considerable disputes respecting their comparative

efficacy. After a variety of trials have been made, and a multiplicity of cases detailed, the practice still remains ambiguous and undecided; and methods of treatment diametrically opposite at the present day, enlist nearly an equal number of advocates.

The two modes of treating burns and scalds, which have recently acquired the greatest share of notice, are those of Mr. Kentish and of Sir James Earle. The former of these consists in the use of stimulant, the latter of cooling applications.

Mr. Kentish recommends that the injured surface be in the first place washed and bathed with rectified spirit of wine, spirit of turpentine, or some similar application, which has been previously heated as far as it can be borne with the finger. After this bathing has been repeated two or three times, the whole is then to be covered with plasters made of common basilicon or resinous ointment, thinned to the consistence of a liniment with spirit of turpentine. This dressing is to be continued for twenty-four hours, after which its place may be supplied with some less stimulating substance, such as proof spirit or laudanum, with the coldness taken off. At the end of forty-eight hours, Mr. K. observes, the inflammation will generally be found to have disappeared, at which time the part may be dressed with camphorated oil, with Goulard's cerate, or with cerate of lapis calaminaris.

The internal treatment recommended by Mr. Kentish, is also stimulant. Wine, ale, alcohol or laudanum, are advised to be used according to circumstances.

Sir James Earle, in a publication, entitled, "An essay on the means of lessening the effects of fire on the human body," defends a mode of treatment directly the reverse of the former. This consists of the antiphlogistic regimen internally, together with the application of cold in the form of water, snow, or pounded ice, to the part affected. Sir Walter Farquhar and Dr. Kinglake, advocate the same mode of procedure; and the cases related to substantiate the happy effect of the cooling treatment are not less numerous than those in favour of the terebinthinate remedies.

The disputes on the comparative efficacy of the foregoing plans of treatment have been agitated with so much warmth,

and so little impartiality, that the reader of them is like to end his inquiries in complete scepticism rather than in conviction. Inconsistent and opposite facts are often stated, and the same cases distorted to prove both points of the dispute. For instance, the remarkable case of Boerhaave, who was violently scalded by the bursting of Papin's digester, and who got well under copious bleeding and purging ; is cited by one, as an instance of a speedy and fortunate cure ; and by another as a very tedious and difficult recovery, which might have taken place in half the time under a different mode of treatment. The source of this uncertainty seems firstly to consist in making practical deductions from individual or insulated cases, which do not afford sufficient room for a comparison of the effect of different remedies. Such is the idiosyncrasy of different constitutions, and so deceptive the appearance of different injuries, that it is often impossible to pronounce in what degree two cases resemble each other, and in what degree any application has actually expedited or retarded the cure.* According to the caprice or prejudice of practitioners the account of a case may be warped and coloured in such a manner as to prove almost any point of a dispute that is wished. For example, should any one come forth as the advocate for a *negative mode* of treating burns, which should consist in letting them alone, or in leaving the process to nature ; there is no doubt that in due time he would be able to collect a sufficient number of apparently satisfactory cases to answer all his purposes. The multitude of cases brought forward by Mr. Kentish and his opponents, in the aggregate, seems only to prove, that oil of turpentine and cold water are both salutary, and both pernicious, according as the practitioner who watched their influence, was under prejudices of a favourable or unfavourable nature toward either application. A second ground of error is likewise contained in the supposition, that a single and specific mode of treatment can be accommodated to all states and degrees of the injuries occasioned by fire.

It is obvious that many more cases may yet be detailed which will not bring the question, in the least, nearer to a decision.

* Some very appropriate remarks on this subject, are contained in Mr. Kentish's essay.

Though a series of observations by a faithful and intelligent practitioner is always entitled to respect and attention ; yet when two such courses present us with results diametrically opposite, we are justified in doubting the validity of the ground on which they are founded.

It occurred to me, that could a method be devised of inflicting two equal burns on corresponding parts of the same animal, which should afterward be treated with different applications, that a tolerable chance would be afforded of testing the comparative efficacy of these applications. With this view the following experiments were instituted, which, though not so numerous and complete, as could have been wished ; will not, it is hoped, be thought altogether inapplicable to the object for which they were attempted.

EXPERIMENT I.

The two ears of a full grown rabbit were immersed in water, heated near to the boiling point. Particular care was taken to immerse both ears at the same instant, to plunge them to the same depth, and to withdraw them together. In this way two scalds were obtained, as nearly as possible, equal ; since they were inflicted by the same substance at an uniform temperature, applied for an equal extent and length of time, to parts corresponding to each other, equidistant from the centre of circulation, and both appertaining to the same subject. The animal was now suspended on his back with his right ear immersed in a vessel of warm water, at about 100° of Fahrenheit ; the left in a vessel of cold water, having its temperature reduced by ice. In this way they continued for three quarters of an hour, the temperature of both vessels being kept regular as possible by the occasional addition of warm water and of ice. The two ears were then wiped dry and covered with common resinous ointment.

2d day—The right ear to which warm water had been applied was red and opaque, but the skin remained sound ; the left was evidently more inflamed, and contained several small vesications and excoriations. The heat of both was somewhat above the natural standard.

3d day—The cuticle had separated from both ears to some extent, but most from the left to which the cold application had been made. A small slough likewise separated from this ear.

4th day—Additional portions had separated from both ears, but most from the left.

From the 5th to the 18th day both ears continued in a state of ulceration. The tip of the ears having been the first part immersed, and the last withdrawn, was of course the most intensely scalded, and sloughed off from both to some extent. The left ear, which had undergone the cold treatment, suffered most by gangrene, and was several days later than the other in healing.

EXPERIMENT II.

The two ears of a rabbit were immersed in scalding water as formerly. The right ear was covered as far as it was scalded with the stimulating ointment of Mr. Kentish, made of basilicon, thinned to the consistence of a liniment with oil of turpentine. To the left ear was applied a saponaceous liniment, composed of equal parts of lime water and olive oil.

Three hours afterward the ears were examined. The heat of both was much increased, but that of the right to which the spirit of turpentine had been applied was evidently greatest. The pain of this ear was likewise evinced by the animal lopping it, or laying it on his back, while the other was carried upright. Some small blisters had risen on this ear, but none were observed on the other.

2d day—Both ears were preternaturally warm and red, the right continuing more so. They were now covered with resinous ointment.

3d day—A part of the tip of the right ear separated, and some of the remainder appeared destitute of sensation. The left was red and inflamed, but with no appearance of mortification.

4th and 5th days—More of the right ear came off. The left was ulcerated, but without any appearance of gangrene.

6th—8th days—The ulceration continued without any slough from the left ear. About the 9th day, the weather which had

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been temperate became cool; and the ears, which were kept moist by the ointment and their own discharge, became constantly cold. To this circumstance I attributed the formation of a considerable slough which came from the right ear about the 10th, and from the left on the 14th day. Both ears soon after healed.

EXPERIMENT III.

The ears of a rabbit being equally scalded as before, the right was covered with Mr. Kentish's ointment; while the left was immersed in cold water with ice for three quarters of an hour. The left was then covered with basilicon, which ointment on the second day was applied to both.

2d day—The right ear was blistered, and discharged a considerable quantity of serum or pus. The left was in a similar situation, but in a less degree.

3d day—Both ears were in a state of suppuration, but the right much the worst; the discharge from this ear being general, from the other partial.

The right ear continued to appear the worst during the recovery, which was not complete before the 30th day. The loss of substance by sloughing was not great from either ear, but was least from the left.

EXPERIMENT IV.

A fourth rabbit was dipped in the same manner with the others; afterwards one ear was immersed in water, the other in proof spirit at the temperature of the room. The scalds, however, proved to be slight, as nothing ensued but a trifling redness and opacity in the parts immersed, which disappeared in two or three days, and nearly at the same time from both. This experiment would not have been mentioned, did it not serve to shew the ground for fallacy, which arises from comparing the cases of different individuals. Had the result of this case been contrasted with any of the former, on presumption that the injuries received were equal; a very erroneous deduction would probably have been the consequence.

The foregoing experiments were conducted on a plan, which, I conceive, were it pursued to a suitable extent, would approach as near to demonstrative certainty, as any subject in the conjectural science of medicine is capable of arriving. A desire of the truth, however, obliges me to state the difficulties which remain, and which may seem to detract something from the weight of the experiments. The ear, which was the part subjected to experiment, is composed chiefly of cartilage and skin; it is remote from the centre of circulation, and its powers of life comparatively feeble. *Possibly* a different mode of treatment may suit this part, from that which agrees with muscles and cellular substance. This is not to be considered as very probable, since the living animal fibre generally exhibits similar phenomena in any part of the body under the influence of the same disease. If any peculiarity existed in the ear, it was probably that of being less susceptible of the action of stimuli. A trial would have been made with some more central part had the operation been equally convenient. A second imperfection in these experiments was caused by the accession of cold weather, which apparently occasioned a more extensive gangrene, than would have ensued under the use of the remedies, without this circumstance. It did not, however, occur during the first days, so that the following appearances may be considered as free from fallacy.—1st, The evident increase of heat, pain, redness, vesication, and gangrene, following the application of oil of turpentine. Exp. II. and III.

2d. The increase of most of the same appearances, where cold water was used in contrast with warm. Exp. I.

As comparative cases come within the plan of these remarks, the following case, in which different remedies were applied to the same subject, is extracted from the *Med. and Phys. Journal*, vol. 18. page 209.

“Samuel James, aged 40, had his face, hands and back most severely burnt by the explosion of hydrogen gas in a coal mine. The cold application was used to the face and hands; the warm oil of turpentine, according to Mr. Kentish’s plan (originally recommended by Heister) was applied to the back, and dressed afterward with unguent, resinæ flav. softened down with the same; in order to try which mode of treatment afforded the most

immediate ease to the patient, as well as the most expeditious cure. According to the patient's own account, the pain of the hands and face was immediately relieved by the cold application, but he complained of the oil of turpentine occasioning a smarting sensation on the back for five or six hours. This mode of dressing was continued for the space of two days; but observing a considerable degree of inflammation remaining from the terebinthinate application, that dressing was changed for the neutralized cerate, which the patient did not observe, his eyes being closed by the great tumefaction of the face; but he expressed the utmost satisfaction from the superior comfort he felt in that dressing compared with the former. The next day the back appeared much less inflamed, continued gradually getting better, and was cured in three weeks. "I am confident," says Dr. Evans, the relater of the case, "the back would have gotten well sooner under the cooling plan of treatment; for the patient constantly complained of the great heat in the part during the application of the oil of turpentine."

In a variety of cases which have occurred under my own observation, it has not been practicable to contrast the effects of different dressings; so that little of a decisive nature can be gathered from them. In one case, however, which I witnessed, of a very severe and extensive burn in a child aged ten years, which was occasioned by the clothes taking fire, and which afterward terminated fatally; the application of the oil of turpentine in the form of a liniment, produced the most violent aggravation of pain, which did not cease before the patient was thrown into convulsions. Instances of the same effect have been mentioned to me by several medical friends.

Most writers, who appear as principal advocates of any mode of practice, feel obligated to produce something like a theory or rationale, which shall account for, or at least apply to the facts and phenomena adduced. Accordingly, Mr. Kenūsh and the others have not omitted to back their catalogue of cases with a train of reasoning illustrative of the propriety of their favourite applications. Of these the two principal are entitled to a separate attention.

OF THE STIMULANT PLAN.

In defence of the oil of turpentine and other stimulant applications, Mr. Kentish states the following as a *law of the system*. "That any part of the system having its action increased to a very high degree, must continue to be excited, though in a less degree, either by the stimulus which caused the increased action, or some other having the nearest similarity to it; until by degrees the extraordinary action subsides into the healthy action of the part." It has also been urged by supporters of the plan, that a lesser stimulus, as the oil of turpentine, is comparatively *sedative* in its operation on a part violently excited by a burn. The above reasoning may amuse the imagination, but does not satisfy the judgment. The analogy of almost every subject in medicine and surgery teaches us, that a part already highly irritated receives no benefit from an additional stimulus, which must tend only to increase the sum of the irritation. If a man bruise his finger, do we, by way of expediting the cure, proceed to bruise it again, but with less violence, because "it must continue to be excited in a less degree" "until the extraordinary action subsides into the healthy action of the part?"—Or if a man has received an hundred lashes, shall a surgeon prescribe ninety more, because ninety lashes are less stimulating than an hundred, and therefore comparatively sedative?—The propriety is just the same, when we irritate with acrid spirit of turpentine, a part already suffering violent pain and inflammation, as well as increased sensibility, from a burn. Though the spirit of turpentine applied to a healthy surface is less injurious than fire, yet if we apply the one to a part already injured by the other, we only inflict a double evil, or produce an aggregate of the mischief of both.

With regard to the internal stimulant plan of Mr. Kentish, it is advocated on a ground not less exceptionable. He assumes it as a fact, that "a healthy vigorous man" suffers less by a burn of the same extent, than "a man of an irritable habit;" and from thence he infers that strength resists the ill consequences of these injuries, while weakness promotes them; and that therefore in all cases "we should make the system as strong as we

can immediately on the attack." Whether this principle be just may very properly be questioned, since it is an undoubted fact that from ordinary mechanical injuries, a vigorous, plethoric man suffers a higher degree of inflammation, than one whose strength and quantity of blood are less, and whose powers of reaction of course are more feeble. When a common injury takes place, which is capable of producing inflammation and symptomatic fever, depletion and the antiphlogistic regimen are resorted to as preventives; and this in a greater or less degree, according as the subject is more or less plethoric. For instance, if a vigorous man receive a contusion on any part of his body, so violent as to endanger suppuration or gangrene; we prevent or mitigate these symptoms by blood-letting, purging, and abstinence. Now if the same man had received a burn on the same part, endangering the same symptoms, ought our practice to be different? Is the system so revolutionized as to require opposite treatment, because an injury is caused by fire instead of mechanical violence? Or is a stout and plethoric patient, with a full, hard, and frequent pulse, to be stimulated with brandy and laudanum, because his fever originated in a burn? It is certainly the height of empiricism to prescribe a specific mode of treatment for a disease, merely from its name. A rational treatment is always dependent on circumstances, and is stimulant or sedative, according to the constitution of the patient, the state of the pulse, and the condition of the system.

OF THE COOLING PLAN.

Sir James Earle, and Dr. Kinglake, the former in his Essay, and the latter in the Med. and Phys. Journal; have advocated a mode of treatment precisely opposite to that of Mr. Kentish; yet like him they seem to have erred in pursuing a favourite remedy to extremes. The general and continued application of cold to a part injured by a burn or scald, is resorted to, from a belief of its tendency to abstract the excess of caloric from the part, and to restore the equilibrium. This belief is a just one, so far as it applies to the application of cold for a short time, immediately after the injury from a heated substance is received; but the continued application of it for hours and days on

the same principle, is altogether unphilosophical, and has been sufficiently refuted in the treatise of Mr. Kentish. Every particle of caloric communicated to the living body by a hot substance may be abstracted in one minute by plunging the part affected in cold water; and if this immersion be continued, the temperature will soon be reduced below the natural standard. It is true that on withdrawing the affected part, its temperature will soon rise to the former pitch; but this increased temperature can be nothing more than animal heat, a little increased by the violent *action* of the part; as happens in most cases of inflammation. As to the common phrase of "killing the fire," by which is meant only the relief of pain that takes place at the commencement of resolution or suppuration; this cannot be hastened by cold applications, except in slight cases which admit of resolution; whereas, in cases where blisters have arisen, and suppuration is about to take place, its progress is only retarded by the employment of cold.

With regard to the antiphlogistic regimen, nothing more need be said, than that its use or omission must be determined on, altogether from the state of the system.

It may be proper in this place to say something respecting the use of alcohol, ether, and proof spirit. These substances are often recommended in a vague manner, without reference to the mode of their application, although on this circumstance depends their efficacy. If a part of the body be washed with cold spirit, or a thin cloth wet with spirit be applied; the rapid evaporation which takes place, renders the effect powerfully refrigerant. On the contrary, if the part be immersed in spirit, or the spirit be applied warm, or with a thickly folded cloth; its operation is unquestionably that of a stimulant.

After considering at length the opposite extremes of treatment, which have been adopted; the result of both reason and experiment appears to be, that the two extremes are alike injudicious, when pursued in their full extent; and neither of them suited to the varieties of burns and of constitutions. An intermediate plan of treatment, which shall vary according to circumstances, and be dependant on the degree and state of disease, is undoubtedly the most deserving of attention.

In slight burns where no vesications take place, and where resolution appears practicable, we should resort to cold applications, either of water or of spirit; since in this way the most speedy relief is generally given to the pain, and likewise, as in other inflammations, resolution is accelerated. The preparations of lead, or any other discutient, may be added when thought proper. In all cases of burns and scalds it may be expedient to make one application of cold water as soon as possible after the injury, to abstract the heat from the clothes, skin, &c. and prevent the spreading of its effects.

In more violent burns, attended with blisters and acute pain, a permanent relief is to be expected only from suppuration. This is promoted, as in other cases of suppurative inflammation, *not* by acrid stimulants, *not* by snow and ice; but by mild emollients and warm fomentations or poultices. Though cold applications by benumbing the nerves may afford a temporary relief of pain, yet this returns with equal or increased violence when these applications are discontinued; so that they must be persevered in for a long time, until tardy suppuration appears in spite of them, before effectual relief is given. In the first experiment on the rabbits, the ear which was immersed in cold water fared worse than its fellow, which was dipped in warm. In the treatment of burns tending to suppuration, perhaps no application is better than a liniment of lime water and oil. This is very gently stimulant and astringent, and by its saponaceous quality unites with the discharge, and is thus more generally and equally applied than any unctuous substance would be in its place.

In very violent burns, where the life of a part is destroyed, or where the inflammation is so great as to render mortification to a considerable extent probable; our treatment must depend on the state of the system, and the appearance of the part. If marks of active inflammation are present, with increased heat and force of circulation, a sedative and depleting plan is to be followed, until the violent action has abated. On the contrary, if the inflammation be of the passive kind, with diminished action of the part, and atony and prostration of strength in the system; we must then depend on stimulants and antiseptics. It can be only

in burns of this kind that Mr. Kentish's method of treatment is admissible in any extent.

In the subsequent treatment of burns, if exuberant granulations arise, they may be repressed by gentle astringents, by pressure, or by escharotics. Mr. Kentish recommends powdered chalk, but this I have found insufficient, when mixed with a third part of burnt alum. Pure allum answers the purpose perfectly well. The separation of sloughs is facilitated, according to Mr. Kentish, by introducing powdered chalk into the cavities between them and the living parts.

The contraction of the cicatrix is often an unpleasant consequence of burns. It may be obviated in a degree by a proper position of the cicatrizing part. Sometimes the contraction is so great as to impede circulation ; in which case it is necessary to divide the newly formed skin in different places, thus allowing it room to expand.

The foregoing observations are part of a manuscript dissertation "on Burns and Scalds," written for a former occasion.