on the following day, he was almost carried on board ship. For the first week after he sailed from Calcutta he could not leave his cabin. He had an attack of ague, with, for two days, such sickness of stomach that nothing remained on it. After recovering from this ague-fit, he gradually gained strength, so that five weeks later, when he arrived at Southampton, he could walk unassisted, and move his fingers better. There was, however, utter and complete inability to raise the arms from the side. He was, however, able to move a book or pull a light chair if he could get a hand on it. The pains which were present early in the disease disappeared altogether when the arms became powerless. There never was the slightest diminution of sensibility in either arm; if an arm were subjected to pressure by lying on it, the sensation of "pins and needles" was experienced.

On June 26th, I was consulted by the gentleman whose history, from his own notes, I have detailed. His arms hung powerless by his side; all the muscles of the arm and forearm, and the muscles around the shoulders, were much wasted; his head slightly drooped. The sensibility was perfect. His legs were thin, but he could walk well. I requested to have a consultation with Dr. Stokes, who saw him with me on the following day. We recommended electro-galvanism, needles being inserted into the skin; and salt water shower-baths, followed by friction to the arms. We also advised him to take a drachm of the syrup of the phosphate of iron, strychnine, and quinine, three times a day. He found that, although the shock was slight, the needles caused sickness; so that he resumed his former mode of applying the current. From the time when this gentleman was seen by Dr. Stokes and myself (June 26th) until the beginning of November, he had an attack of ague about every ten days. Living at the seaside, he took a salt water shower-bath daily, and had his arms and shoulders well rubbed with a flesh-brush. He also continued the electro-magnetism and the syrup. He almost lived in the open air. The treatment he continued up to December. The syrup he ceased to take at the end of September, and the application of the electricity was discontinued in a month afterwards. By the end of November he could feed himself, cut his dinner, pull a light oar, steer a boat, also write freely; but he could not raise a weight, or pull on a heavy coat.

On December 19th, I saw the patient, and was most agreeably surprised at the progress he had made. There had been a manifest increase of muscle, not only of the wasted parts, but of the body generally.

On the 8th of the following month (January), he went to St. Anne's, Blarney. He commenced to take hot-air baths—four in the first ten days, remaining an hour or more in the bath. He found himself weaker, which to some extent he attributed to giving up wine and beer. He subsequently took a bath each day, followed by energetic shampooing, remaining only half the time in the bath that he had done at first. He again improved; and, after a sojourn of two months at Blarney, during which he took a bath daily, he left it decidedly improved, and better able to walk up and down hill than on his arrival.

On March 4th, after a drive about Dublin (the day being very cold), he again had an ague-fit, the first since January 6th. The attack was unusually severe. On this occasion, the shivering fit was followed by very high fever and headache of intense severity. Finding I was out of town, he sent for Mr. Butcher. After some days, he recovered, and went to Bray, where he resumed the use of the hot-air bath. By the middle of April he was able to walk round Bray, and from this date he had no return of ague; and he winds up the notes with which he kindly furnished me by saying, "I feel myself so well that I believe myself now (May 24th, 1868) quite capable of undertaking work again." From this time he has continued well, and is now engaged as engineer of a railway.

THE HOSPITAL FOR SICK CHILDREN.—We are requested to intimate the following liberal arrangements for clinical teaching at this hospital:—"That the practice of the hospital be thrown open gratuitously to the pupils of the different hospitals and medical schools in London; but that not more than four from each school be offered the privilege at one time. That the admission be limited to a period of three months, but be renewable on application. That the pupils so admitted bring with them recommendations from one of the medical officers or teachers of their school, and that they receive from the House-Surgeon a ticket authorising them to attend the practice. That the names of gentlemen so admitted, with the date of their admission and the schools with which they are connected, be entered in a book; and that, if their attendance be regular, they shall receive a certificate testifying to such attendance. That, in order to render such visits more useful, each of the senior medical officers engages to give clinical instruction at the bedside, or after the visit, once a week." This arrangement will commence on Tuesday, January 17th.

ON A CASE ILLUSTRATING THE PRESENT ASPECT OF THE ANTISEPTIC SYSTEM OF TREATMENT IN SURGERY.

By JOSEPH LISTER, F.R.S.,

Professor of Clinical Surgery in the University of Edinburgh, etc.

A YOUNG man, eighteen years of age, was lately admitted under my care in the Royal Infirmary on account of impaired usefulness of the right arm, resulting from an accident which befel him three months previously, when the handle of a winch, revolving with great rapidity, struck the limb at the posterior aspect, about three inches below the elbow, breaking the ulna and dislocating the upper end of the radius forwards, the lower ends of the bones of the fore-arm being tilted backwards to a corresponding degree. He at once sought medical aid; but, strange to say, the nature of the injury was not recognised, and the result was that when I saw him the fragments of the ulna were firmly united at an obtuse angle with each other; a marked depression existing posteriorly over the seat of fracture, while the head of the radius formed a prominence at the anterior and outer aspect of the joint, being securely maintained in its abnormal position through the connection of the other end of the bone with the lower end of the ulna. The elbow could not be flexed beyond a right angle, so that he could not put his fingers to his mouth; and, although the hand could be rotated passively, he was quite unable himself to execute pronation or supination. He also complained that the limb was so weak that he could not lift any heavy object from the ground, and expressed great desire to have this faulty state of matters rectified.

It was plain that before an attempt at reduction of the dislocated radius could be made with any chance of success, it would be necessary to break again the united ulna. But, considering the length of time that had passed since the accident, and the slightness of the leverage that could be obtained upon the seat of fracture so near the elbow, it seemed hardly likely that this object could be attained without a cutting operation. And even supposing the bone to give way, I felt it very doubtful whether the dislocation could even then be reduced, both on account of its long duration and because the angular form which the ulna had assumed implied a shortening of the fore-arm, which at that late period necessarily affected all its textures. On the other hand, there could be little doubt that, if the ulna were exposed and divided, and if, further, the head of the radius were removed, the limb could be at once restored to its proper form. But to do this would be to make voluntarily a compound fracture of the ulna and a compound dislocation of the elbow-joint—a procedure which, under ordinary treatment, I should have regarded as unjustifiable. But with the means now at our disposal of guarding against the mischievous influence of external agents upon wounds, I believed that these two operations could be performed without any chance of mischief resulting. Accordingly, at a clinical lecture on the 12th December, having explained the aspect of the case, and having failed to rebreak the ulna by very forcible measures under chloroform, I first washed the skin of the fore-arm and elbow with 1 to 20 watery solution of carbolic acid, to destroy all putrefactive particles in the epidermis and hair-follicles, and then made a longitudinal incision about two inches long over the back of the ulna where it had been broken, while an assistant threw over the part a cloud of spray of 1 to 40 carbolic lotion by means of Richardson's apparatus; and, having sufficiently detached with the knife the muscles from the bone, and ascertaining precisely with the finger the situation of the callus, I inserted the blades of a pair of strong bone-pliers, smeared with an oily solution of the acid (1 to 10), and, cutting through the bone, used the pliers as a powerful lever to wrench the fragments sufficiently apart, and detach them enough from surrounding soft parts to insure free mobility, the antiseptic spray being meanwhile constantly maintained. A sponge wrung out of 1 to 40 watery solution having then been bandaged upon the wound, I made an attempt to reduce the dislocation of the radius; but, meeting with the failure I had anticipated, I at once cut down upon its head in a cloud of spray, and removed it by nipping through its neck with the pliers, the blades of which had been again smeared with the oil. A folded cloth dipped in the watery solution having been laid upon the wound, I had the satisfaction of finding the fore-arm assume, under moderate extension and coaptation, a perfectly normal shape. The limb was then enveloped in lac-plaster from the middle of the arm to the lower part of the fore-arm, the sponge and cloth having been previously removed under the spray, the wounds being left unstitched, to secure complete absence of tension from accumulating blood or serum. Cloths to absorb discharge, and a roller smoothly applied so as to adapt the

plaster well to the limb, and a pair of Gooch's splints, anterior and posterior, with a special pad in front over the seat of fracture, completed the dressing, the elbow being kept at a right angle.

Next day, the dressings were entirely changed, when it was found that a good deal of blood and serum had oozed into the cloths. The lac-plaster was cut up with scissors along a line distant from the wounds; and, as it was raised from the limb, the spray of 1 to 40 lotion was made to play beneath it. The gaping wounds were found filled with blood-clot, while the limb was free from swelling, redness, or tenderness. The limb having been washed from bloody stain with a cloth dipped in 1 to 40 lotion, while the wounds were kept covered with bits of rag wrung out of the same, oiled silk "protective",* dipped in the lotion to give it a temporary antiseptic film, was placed upon each wound to protect it from the stimulating action of the acid in the lac-plaster, which was then wrapped round the limb in two layers, extending several inches beyond the "protective" in every direction, after which the splints were reapplied as before.

This dressing was left unchanged for two days, after which the patient was again dressed in a precisely similar manner before the clinical class, walking into the theatre and upstairs again to his bed just like a person affected with a simple fracture or dislocation. His pulse was 70, his temperature 98.2, and he was entirely free from pain. The stain on the cloths corresponded to about half a drachm of bloody serum; the clots remained unaltered in appearance in the wounds, and the limb in the vicinity had still a perfectly natural aspect. Feeling sure that the discharge would now be very slight in amount, I left this dressing untouched till the following lecture, four days later, or just one week after the operation, when the wounds were again exposed before the class. All remained the same, except that while there was no pus, and merely a stain corresponding to a few minims of serum as the product of both wounds for four days, the blood-clots had been extensively converted into vascular tissue, while some portions yet unvascularised had assumed a grey or yellowish colour, and in both wounds there was a broad cicatrising margin. Healing, though under a moist dressing, was going on as under a scab; or, in other words, putrefaction being excluded by means of an efficient antiseptic guard, while the exposed tissues were protected from the action of the antiseptic salt by the interposition of a layer of unstimulating material, the disturbing influence of external agency was avoided, and we attained very closely to the conditions of a subcutaneous injury.

On this occasion, instead of the lac-plaster, a folded muslin cloth, of open texture, imbued with a mixture of paraffin, resin, and carbolic acid, was employed to combine the functions of the lac-plaster and absorbing cloth. Hitherto I have been opposed to porous antiseptic dressings, having observed that, when in the form of lint steeped in an oily solution of carbolic acid, the discharge, if at all free, washed out the antiseptic liquid from among the neutral fibres, and opened a way for the penetration of putrefaction. But, having heard reports from various quarters of the efficacy of oakum, I have lately put it to the test with granulating sores, where, if it should happen to fail, no mischief would result, and I have found it more than answer my expectations. The reason for its superiority over oily cloths is readily intelligible. Each fibre of the oakum is imbued with an insoluble vehicle of the antiseptic; so that the discharge in passing among the fibres cannot wash out the agent any more than it can when flowing beneath the lac-plaster, to a narrow strip of which an individual oakum fibre is fairly comparable. I may remark as worthy of notice by those who still cling to the idea that carbolic acid has some unknown virtue distinct from its antiseptic property, that oakum contains none of that substance, but creasote and probably other antiseptic hydro-carbons, the effects of which in preserving smoked meat are familiar.

Oakum not only proved efficient antiseptically, but presented several advantages over lac-plaster. When the latter is left as a dressing for several days together, the discharge, even though small in amount, soaking into the absorbing cloths, loses the carbolic acid it had received from the plaster, and putrefying from day to day, assumes an acrid character, and sometimes produces most troublesome irritation of the skin. This is, of course, avoided by the oakum. Again, the lac-plaster being quite impermeable to watery fluid, keeps the skin beneath it moist, and, in fact, covered with a weak watery solution of carbolic acid, which, I suspect, insinuates itself, more or less, beneath the protective, and maintains a slight stimulating influence upon the parts

beneath it. But oakum, draining away the discharge as fast as it is effused, avoids this source of disturbance. The result is, that if a granulating sore is thoroughly washed with an antiseptic lotion and covered with "protective" and a well-overlapping mass of oakum secured with a bandage, a dressing is provided which nearly approaches the ideal I have long had in view. For, as granulations do not form pus or even exude serum except when stimulated, a persistent antiseptic, combined with an efficient protective, should constitute a more or less permanent dressing under which discharge should cease and cicatrization proceed with great rapidity. Accordingly, ulcers of the leg treated in this way have been found, when exposed after the lapse of several days, either entirely healed or greatly advanced in the process, while the moisture beneath the protective has been of a serous character and the discharge collected in the oakum comparatively small in amount. Lastly, the lac-plaster has this further disadvantage from the moisture beneath it, that it prevents efficient strapping in cases that require it. But under oakum an adhesive plaster retains its hold as well as under dry lint.*

But while oakum has these great advantages, it is disagreeable to many persons from its strong tarry smell; and I have been lately endeavouring to apply the oakum principle in some shape free from this objection. Oakum consists of the detached fibres of old ropes which had been treated with Stockholm tar, among the constituents of which is common resin. I happened to notice, several years ago, that resin holds carbolic acid with remarkable tenacity, so that if one part of the latter be mixed by melting with five of the former, the glutinous mixture which results on cooling communicates only a slight warm taste to the tongue, though containing so large a proportion of the pungent antiseptic. But this material is of itself too sticky for the purpose, and resin is, besides, somewhat irritating to delicate skins. Paraffin, another constituent of tar, is remarkable for its entire absence of adhesiveness, as well as for its perfect blandness; but when pure, though it may be mingled with carbolic acid in the melted state, it separates entirely on cooling. If, however, the three ingredients be melted together, the resin, though intimately blending with the paraffin, still retains its hold upon the acid after cooling, and by a proper proportion between them, a product is obtained which, while intermediate in physical properties between the glutinous resin and the powdery paraffin, is unirritating to the most sensitive skin and highly retentive of the acid, while almost destitute of odour.†

Cheap muslin gauze dipped in the melted mass, and well wrung or pressed while hot, is an elegant and convenient form of modified oakum. It should be folded into about eight layers; and in order to prevent the discharge from soaking too directly through it, a piece of thin gutta percha tissue may be placed beneath the outer layer to guide the fluid towards the edge of the cloth.

Such was the dressing employed a week after the operation. Three days later, the wounds were found still healing rapidly without suppuration, and, on rotation of the hand, the end of the radius was felt moving in its proper place, while the ulna presented a slight convexity backwards, instead of its old concavity. The patient who had been till then confined for the most part to bed, as a matter of precaution, was now allowed to get up, a similar dressing of "protective" covered with antiseptic gauze having been applied.

Four days afterwards, on the 26th instant, the dressing was again changed, when the wound over the ulna was found almost healed, and that over the joint far advanced in cicatrization, while there was still no pus or putrefactive odour, and the general health of the patient continued excellent.

In some respects it would have been more satisfactory if sufficient time had passed to permit reunion of the ulna, so that the usefulness of the limb might be tested. But as an illustration of antiseptic treatment, the case is already complete. In this respect, I cannot but hope that it will be thought instructive. It is an example of a procedure, otherwise highly dangerous, if not unwarrantable, rendered not only legitimate, but entirely free from risk, simply because, from the

* Antiseptic adhesive plaster is readily improvised by dipping ordinary strapping in a hot solution of carbolic acid made by mixing one part of 1 to 20 lotion with about two parts of boiling water. When used in this way, strapping will adhere to a moist skin, so that it may be applied under the spray when circumstance render this desirable.

† The proportions which I have hitherto found to work best are, sixteen parts of paraffin, four parts of resin, and one part of crystallised carbolic acid. I am far from supposing that this first attempt at improving upon oakum affords the best result attainable; and I propose to institute experiments with various other constituents of tar. But it seems worth while to mention the result already arrived at, because, while it certainly works well in practice, its constituents are obtainable where lac-plaster may not be so. It has the further advantage of being a very economical dressing. For the gauze loses the paraffin and resin entirely when washed in boiling water, so that it may be used over and over again, while about a halfpenny covers the expense of the ingredients required to charge a square yard.

* This protective is made by varnishing oiled silk on both surfaces with copal varnish, which renders it considerably less permeable to carbolic acid, and when dry it is brushed over with a mixture of starch and dextrine to give it a film of material soluble in water, so that it becomes uniformly moistened when dipped into the antiseptic lotion. It may be obtained of the Apothecaries' Company, Virginia Street, Glasgow. When it is not at hand, common oiled silk may be used as a substitute for it, if smeared with an oily solution of carbolic acid, and used in two layers to make up for its inferior efficiency.

circumstances of the case, and the improved means at our disposal, we could calculate with certainty on avoidance of putrefaction. I venture to draw special attention to the use of the spray. In every wound treated antiseptically, two things are always to be attended to: first, to leave the wound free from living putrefactive organisms, and, second, to employ such an external dressing as shall securely prevent the entrance of such organisms at any subsequent period of the case. The latter point has, in most cases, been for a long time past satisfactorily accomplished; but the former, till we used the spray, was always a matter of more or less uncertainty. A floating germ might enter during the operation into some cellular interstice among the tissues, and, becoming surrounded with a clot of blood, might escape the action of the antiseptic lotion with which the wound was washed, and, retaining its vitality, might subsequently propagate its kind, and spread putrefactive fermentation through the wound. But by help of the spray we operate in an antiseptic atmosphere, and effectually prevent putrefactive organisms from ever entering the wound alive. We thus dispense with the necessity for washing the wound at all with an antiseptic lotion, and in the particular case above related, not even the vapour of carbolic acid penetrated into the deeper parts of the wounds, which were thus left as free from irritation as if they had been made subcutaneously.

The spray is also of the greatest value during the stitching of such wounds as require it, and rids us of the troublesome and uncertain process of distending the wound with lotion by means of a syringe, after the introduction of the last suture. In the changing of dressings, also, the spray is in some cases, and especially in stumps after amputation, a great element of security.

Revision of the proof (Jan. 11, 1871) affords me the opportunity of giving another report of the progress of the case. On dressing the limb yesterday, after an interval of five days, I found the ulnar wound entirely healed, while at the site of the radial incision two or three granulations about as large as pins' heads alone remained to cicatrize, and an odourless serous stain of about a minim upon the gauze was the only appearance of discharge. The ulna seemed already firmly united; and, after performing passive motion throughout the range of the natural movements of the joint, I directed him to try its powers. He could himself pronate and supinate the hand, could extend the arm completely, and readily put his fingers to his mouth; and he lifted a heavy pair of tongs, exhibiting already a strength very superior to that which he had before the operation.

Edinburgh, 31st December, 1870.

OBSERVATIONS ON THE TEMPERATURE OF THE BODY IN HEALTH AND DISEASE.

BY WILLIAM SQUIRE, L.R.C.P., London.

NO. I.—NORMAL TEMPERATURES.

IN presenting to the profession, through the medium of our JOURNAL, a series of observations on the changes of temperature met with in disease, it may be useful to precede them with some comment upon what is known of the laws of the variations of temperature in health. Without this, not only would the significance of many of the facts bearing upon the natural history of disease lose their significance, but the therapeutic value of many of the practical deductions, always foremost in view during these investigations, would be unappreciable. The attainment of truth even in the simplest inquiries is so difficult that, in spite of the careful attention of most honest searchers after it to this particular question, some obscurity and uncertainty have collected round many of the elementary facts relating to the range of temperature in the human economy.

The limits within which the temperature of the human body may vary in disease is very generally found so closely to correspond with the observations of Andral,* that clinical thermometers are now conveniently constructed to register only from 95 to 110 deg.; and though recent Indian and Abyssinian experience shows that the higher range must be still further extended, conclusive instances are yet wanting of the temperature of the interior of the body having undergone a depression beyond the lower limit.

The normal temperature of man is but little influenced by climate. Observations reported by M. de Blainville show that both in the tropics and the polar regions it is equally maintained at, or near, 98½ degrees (*Comptes rendus de l'Académie des Sciences*, 1838, tome vi, p. 457). Climate does not modify greatly the diurnal variation of normal tem-

perature. Of this, scientific evidence is given in the careful record by Dr. John Davy, of the results obtained upon himself during a winter in England in 1844-45, for comparison with similar observations made in Barbadoes from July 1845 to November 1848; where, with a difference of from twenty to thirty degrees in the air of his dwelling, in both cases the average temperature of the body is 98.4 degrees; in Barbadoes the evening temperatures appear to be higher than those of the morning, a difference traceable to the morning and evening observations having been made at a later hour in the colder than in the warmer climate (*Physiological Researches*; London, 1863, pp. 14 and 44).

The daily range of temperature in the adult has hitherto been taken to be much less than in reality it is. Those observers who have made themselves subjects of experiment, either from having neglected the ordinary exercise of active life, or from some other oversight, have not reached a sufficiently high mean daily temperature, so that their results give a daily range of one degree only, instead of a range of two and a half or even three degrees, as may frequently be found in health.

A diurnal variation of temperature, sufficiently constant to cause a continuous elevation at and after mid-day, and a tendency to depression at and after midnight, undoubtedly exists. This has no direct or necessary relation to the hours of the day, but depends upon quite other causes indirectly related.

Rest lowers temperature; exertion raises it. Dr. Houghton has shown how every elevation of bodily temperature represents so much work done, so much force expended, so much waste; on the other hand, we may see how that every active employment in which we are engaged is accompanied by an elevation of temperature. Rise from a warm bed, dress in the cold air, or bathe in the coldest water, and half a degree Fahrenheit of temperature is gained; the day's duties will before long demand another half degree; out-door exercise still more. Thus it will rarely happen that a temperature of 99 degrees, even in the axilla, is not reached by noon.

Strong out-door exercise will cause an elevation of from one and a half to two degrees of temperature—a fact of which any one may convince himself by placing a self-registering thermometer under his arm during half-an-hour's brisk walk; in this way a temperature of 100 degrees will generally be obtained: this has hitherto been overlooked. Numerous observations, taken both in warm and in cold weather, not only show this, but that an internal temperature of 100 degrees is frequently, if not usually, attained, and is, therefore, within the limits of normal temperature.

The condition on which this high temperature is to be considered normal, is that it should not be long maintained. Age, constitution, health, and training, as well as outward circumstances, influence both the readiness with which this degree of organic heat is reached, and the readiness with which it subsides. Heat from exercise, when rapidly induced, will rapidly subside, rest following after short exertion. A fall of one degree of heat in half-an-hour, or of two degrees in one hour of rest, in this case, will readily follow. During more prolonged exercise or exposure, some moderation of temperature may be observed: perhaps the want of food begins to tell, though a good meal helps to lower the temperature-disturbance, and so favours the coming on of sleep. After this elevation of temperature, there is generally a greater tendency to subsidence. Sometimes the disturbance occasioned may be so great or so prolonged that neither the food nor the rest needful to repair the waste occasioned will at once exert their powerful aid in lowering temperature; and, consequently, one is either too tired to sleep, or has to pay a heavier penalty for over-exertion.

Exercise and activity raise temperature; rest and repose are the most effective agents in lowering it. Rest is most perfect during sleep, and then the greatest subsidence of temperature is found. Fatigue, if not extreme, conduces to rest; hence, probably, the reason why the evening temperature of the body is generally lower than the morning. It has been said that sleep does not lower the temperature. Rest at any part of the day, mere rest of body, will allow a subsidence of temperature almost to the degree found at night or after sleep, and this even while active mental processes are being conducted in quiet: nor does the occurrence of a short sleep in the course of an afternoon's rest seem to make much difference in the degree to which the temperature is lowered; so that though the lowest temperature is usually found at night and during sleep, the one may have but an indirect dependence upon the other. It is to be remembered that while during bodily exertion the respiratory function is very active, during sleep it is reduced far below the ordinary rate, and that mental preoccupation will often interfere with full and complete respiratory efforts. The relation between sleep and a lowering of temperature is certainly a close one; they have this mutual reaction—sleep favours the subsidence of temperature, and a certain subsidence of temperature seems to be a necessary preliminary to good sleep.

* *Cours de la Faculté*. Paris: 1841. Andral gives the lower limit as 35° centigrade = 95° Fahrenheit; the higher as 42° centigrade = 108° Fahrenheit nearly.