ILLUSTRATIONS

OF A

NOVEL AND SUCCESSFUL

TREATMENT OF PSORIASIS.

BY

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ILLUSTRATIONS OF A NOVEL AND SUCCESSFUL TREATMENT OF PSORIASIS.[1]

I RECOLLECT that the late Professor Syme, when treating of diseases of the ear referred them to two classes, viz., those which were *curable*, "treated by the surgeon;" and those which were *incurable*, "treated by the aurist." A somewhat similar distinction might be made between skin diseases. For there can be few medical men of experience who have not, in vexatious despair, handed over to the skin specialist cases upon which they have for weeks, months, and it may be years, lavished their stock of the conventional remedies of authoritative dermatologists. And in the converse there can be but few medical men of experience who have not had returned upon their hands cases upon which the skin doctor had directed with ostentatious variation his battery of similar specific and similar insufficient remedies. There is, in truth, little question that numerous diseases of the skin are very unmanageable.

It is a common explanation and a common belief that those diseases of the skin which afflict with the most unconquerable tenacity owe their stubborn qualities to some mysteriously morbid condition of the blood—some constitutional bias—which can only be expurgated or rectified by internal remedies, *i.e.*, the *hæmato-cathartico*, which, acting upon the skin, bowels, and kidneys, eliminate the morbid leaven through these channels. And orthodox courses of arsenic, mercury, antimony, iron, etc., alternately with drastic purgatives, are almost necessary elements in the treatment, supplemented though they may be by filthy baths, restrictions in diet, changes of climate, etc. Of the usually inveterate diseases, among the most obstinate, most loathsome of aspect, and most destructive of the general comfort of the sufferer, is psoriasis, or the common English leprosy. And until the present time I have always accepted the conduct of these cases with great reluctance, and got quit of them, I fear, with little of satisfaction to myself or to my patient. Even where improvement occasionally follows upon the use of any of our stock medicaments, that improvement can rarely be predicated with confidence; nor reliance felt that the same remedy will arrest or "stamp

[1] Read before the Glasgow Medico-Chirurgical Society, May 1878.

out" the disease in its inceptive stage, on the occasion of its return. With a return of the disease, a return to a round of the old empirical routine is almost a necessity.

Of the common notions held by even the best informed regarding psoriasis, I will relate an illustration which indeed has evoked the present communication. About eighteen years ago I consulted with the late Dr Macfarlane, Professor of Medicine in Glasgow University, upon the case of Mr G., a gentleman aged 24, who for nine years previously had suffered under a bad form of psoriasis. It was not a *pro-formâ* consultation, for I had exhausted my resources and really wanted help. But Dr Macfarlane, after learning the course of the ailment and of its treatment, frankly stated that he could only sympathize with me in my difficulty, nor would he make any other suggestion than that of beginning *de novo* a round of the old remedies in the hope that one or other of them might occasionally mitigate the severity of the affection. "But depend upon it," said he, "that man's blood has got a taint, his constitution has got a kind of twist, and his disease will never leave him, do what you may."

During the eighteen years that have passed since my consultation with Dr Macfarlane, this case of Mr G. has been continuously under my observation, and my efforts for its cure or relief have been stimulated by the circumstance that my patient is also a much-valued friend. In addition to my own promptings, the suggestion of several eminent specialists have been carried out. There has been careful regulation of diet, habitual exercise in open air—whether in walking, riding, or yachting—changes of climate at home and abroad, etc., together with potent constitutional remedies and local applications, all exhaustively employed. As is common in such cases there have been from time to time occasional gleams of improvement, but never of perfect relief, and his condition on the whole has been so distressing that he shunned society and oftimes "felt weary of his life." In September last the disease was at the worst that I can recollect, and from his head to his feet the eruption was so copious that there existed only here and there some straggling patches of sound skin. Meanwhile, setting aside the mental disquiet and bodily discomfort, he remained of robust habit, and his general health as regards function was good. Such was the state of matters at the end of twenty-seven years of customary orthodox treatment.

About this time, from various indications, I judged that, in advance of most modern authorities, Dr Balmanno Squire of London had given evidence of being a man of progress, and of original conception in his own line of a skin specialist. I therefore, although with much misgiving of any profitable result, recommended my patient to place himself under the care of that gentleman, provided that, after full knowledge of the history of the case, he had reasonable hope of giving relief through some mode of treatment differing from what had so long and so fruitlessly been employed.

Dr Squire, after seeing my patient and hearing all necessary details, expressed his conviction that, unless in a remedy which had recently come within his knowledge, the remarkable properties of which in this disease he had discovered, and in great measure already verified, he would really have had nothing reliable with which to cap the previous treatment. With consideration for the valuable time and other interests of my patient, he resolved to employ double weapons, and to conjoin the use of an internal or constitutional remedy, viz., phosphorus in large doses. But he relied mainly on the new remedy, chrysophanic acid applied locally in the form of an ointment. He began treatment on 24th September 1877 with an industrious energy that my patient felt to be "tremendous," and by 1st October the greater part of the eruption had disappeared. On 26th October my patient left London for Glasgow in a condition of complete freedom from his long-experienced affliction. I saw him on the day after his return, and had him stripped and overhauled, my expressions of surprise and admiration evidently giving intense delight. No transformation from extremest disease to the most perfect health could be more marvellous—no illustration of medical skill more creditable, and no instance of relief from suffering through the use of medicaments more complete. The cure was a perfect work of art, and my congratulations to my patient and acknowledgments to Dr Squire were sincere and heartily expressed. The cure continues complete at the present date—an interval of six months.

I was naturally much moved by this case, as much through the personal interest I had in the sufferer as by admiration of the brilliant efficiency of the new remedy, and its important promise in skin therapeutics. I accordingly gathered from my patient—a gentleman of quick intelligence—all the circumstantial details of the manipulations, and generally of the treatment, some of the incidents of which were very amusing, and all of which I keenly appreciated, as giving me a substantial basis of special knowledge for my guidance in the farther trials that I at once determined to make. For however conclusive the result in this case, it remained to be proved how far that result had been individual, or how far it might be corroborated in an extended experience; and I fortunately chanced to have some peculiarly favourable opportunities, the illustrations of which I will now submit to your judgment. As the antiquity of an old Scottish family was often linked with the inheritance of what Peter Peebles called "a good-ganging law-plea," so will length of years in medical practice be often found linked with the unwilling burden and responsibilities of a case of good-going skin disease.

Miss E., aged 24, in the customary possession of excellent general health, had suffered, with only occasional and partial relief, from

for 14 years

an aggravated form of psoriasis. The principle and the details of treatment pursued in her case throughout this long period had been carefully considered and intelligently carried out. Two of the foremost dermatologists, of whom my friend the late Professor Bennett was one, had been consulted on various occasions, and their suggestions were supplemented by my best efforts. Arsenic, as usual, was administered, even for years continuously. Mercury was given in lengthy alterative courses, and so likewise was iron and other blood tonics. Tar and its analogues, *ol de cade, ol Rusci, liquor carb. detergens*, medicated baths, vapour baths, sea baths, indiarubber underclothing, cotton pledgets saturated with plain water, or medicated dressings covered with oiled silk, etc., *usque ad nauseam*, were persistently and exhaustively employed. The external application of ointment of pine tar for six weeks at a time, on which Dr Bennett placed the strongest reliance, was the only remedy which decidedly influenced the disease; but neither it—although cheerfully submitted to, notwithstanding its repulsiveness—nor any other remedy seemed to prevent the speedy return of the disease, and when it did return no remedy prevented the steady advance of each relapse. Under ordinary conditions, the eruption was so extensive as to leave only occasional islands of healthy skin, and the distress which it occasioned was greatly aggravated by its occupying the scalp, and so necessitating the use of a wig, and by its disfigurement when it extended to the forehead, face, and neck, for which no mask could be devised. When I began treatment on 8th November 1877, the condition of my patient was as bad as at any former period. I followed and rigorously carried out all the details of Dr Squire's treatment, local as well as constitutional. Within four weeks the entire eruption was removed, with the exception of some troublesome little spots which lingered for a few weeks longer. But on 31st December the skin all over was perfectly normal, and at the present date the cure continues complete.

The third case, that of Master C., a boy, aged 14 years, presents some special points of interest. With occasional ameliorations, only achieved in each instance under prolonged courses of varied treatment, he had suffered continuously for seven and a half years, and during the last four and a half years he was, with little intermission, almost constantly under remedies directed from time to time by a distinguished skin specialist. The lad is naturally good-looking, with a frank, pleasing expression, but the disease, which had latterly been growing more troublesome and inveterate, had so covered his body, had so disfigured him by encroachments on his face, eyebrows, and ears, and in its totality had made him so miserable and unpresentable, that he could not venture to school or show himself on the streets, while in the presence of strangers he assumed a depressed and altogether "hang-dog" aspect, which met an observer in furtive side glances. Arsenic, iron, tar, carbolic acid, bitter tonics, saline laxatives—all had been taken internally for lengthened periods. Alcoholic solutions of potash, soap with pitch, mercurial inunctions, and warm baths were in alternate use, while restrictions in diet—at one time exclusively to meat, at another to vegetables, with changes of air, now to the seaside, and now to inland specified localities, formed part of agencies that are here too numerous to mention. The case seemed altogether so unpromising that it required all the confidence I was now acquiring to support me in volunteering to the friends my services, and in requesting that I should have an innings with the new remedy. I hope I need scarcely say that, although I volunteered in this instance, the lad's family, under ordinary circumstances, are ranked among my *clientelle.* I commenced treatment on 9th November 1877, employing precisely the same agents as in the two preceding cases, and on 10th December he was seemingly quite cured, his skin presenting little abnormal, excepting the discoloration like that produced by walnut-juice, which for a few days remains after the discontinuance of the local applications. On 28th December his skin all over was as fair, as smooth, and apparently as free from spot as a fresh sheet of white paper. No cure could, to all seeming, be more complete ; but a month afterwards I detected a slight relapse, exceedingly disappointing to me at the moment, but now regarded with satisfaction, for having enabled me to assure myself that even in such an obstinate case a relapse can be met, and almost instantly "stamped out," by a return to the original remedy. There is an interesting circumstance connected with this relapse which will elicit comment farther on.

Of the remaining cases which comprise my experience of the new remedy, several present no remarkable features either in point of duration or severity, and may therefore be disposed of in short summaries. The chief circumstance to be noted is the unfailing certainty and rapidity with which in each instance a cure has been effected.

Mrs M., aged 60 years, of excellent general health, has been affected for an indefinite period with large coarse patches of psoriasis on front of leg, extending nearly from knee to instep. For a long time stationary, the disease is now beginning to extend. Treatment commenced on 26th November, and cure completed by 16th January 1878. Continues well at present date.

Mr R., aged 48 years, general health pretty good. Has had small scattered patches of psoriasis on the forearms, chiefly over the elbow, and several small patches on legs. Treatment commenced 18th November 1877, and the eruption gone on 8th December. Continues well at present date.

Mrs M., aged 38 years, of excellent health. Has been troubled for many years with numerous small patches of psoriasis scattered over arms and legs, varying often in number—never large or coarse, and never entirely absent. Treatment commenced 16th November

1877, and on 3d December was reported cured. When I last had information regarding this case, about two months ago, it continued cured.

Mr W., aged 24, of excellent general health. Has for two years had large patches of psoriasis on both elbows and both knees, and also several small spots on both forearms. They have given little trouble, and received no treatment excepting scratching, picking, and scrubbing with soap and water by his own device. He now seeks my aid. Treatment commenced 17th January 1878, and on 28th January the disease was so nearly gone that patient discontinued treatment for several weeks. When I discovered this and remonstrated, the treatment was renewed—this time with energy—and with rapidly efficient results. At present date he is entirely free from the disease.

Miss H., aged 13 years, of delicate frame but good general health. Has a large patch of psoriasis on wrist and front of forearm, which made its appearance four months ago, and is now extending. Treatment began 1st February 1878, and on 12th March the disease had disappeared, and patient has since continued well.

John L., aged 12 years, an active, healthy boy. Has been affected with a thick patch of psoriasis, about 2½ inches long, on front of left thigh, a straggling patch of equal length on front of left leg, and a patch about size of half-a-crown on front of right thigh. The patches on left thigh and leg have been observed for more than three months, and are now extending. The patch on right thigh only showed a few weeks back. Reserving the large patch on left thigh for a special experiment with another remedy of my own devising, and to which I will direct attention in the latter part of my communication, I applied treatment as in the preceding cases to the right thigh and left leg. Commencing the same on 17th April, the disease was entirely removed on 2d May.

Miss M., aged 19, of robust frame and good general health. She has suffered much discomfort for the last seven years from extremely diffused psoriasis affecting the head, face, trunk, and limbs. She has tried in a haphazard way many remedies, and carried out the suggestions, and "got tired" using the prescriptions of several medical men who have been casually consulted. This was a severe and extensive case, and I commenced treatment on 21st April with great energy, anticipating difficulty from the coarseness of some of the patches. But the entire disease has yielded with astonishing rapidity. On 3d May there is considerable tenderness of the skin at some parts, chiefly on front of chest, where the intumescence exceeds anything I have yet seen. The brown discoloration will of course remain for some days, but I consider the case substantially cured; have discontinued all treatment except soap and water, and I expect within eight or ten days to see a complete recovery.

Here we have ten cases of psoriasis affecting individuals, whose ages have ranged from twelve to sixty years, where the disease had endured from three months to twenty-seven years, and where it varied from the mildest to the most aggravated form, all treated and each case expeditiously cured within a few weeks by a *local* application.[1] I say "local," because the constitutional remedy of phosphorus, so freely administered in the first case by Dr Squire, and, in imitation of his treatment, employed by myself in three subsequent cases, was not used in others. At an early period I satisfied myself that the characteristic effects of the local remedy were so decided that I could rely upon it alone, and, beyond general attention to ordinary hygienic conditions, no other precautions were necessary. I have reason to believe that Dr Squire now holds very much the same opinion.

So much for the curative results of this novel remedy, the history of which now claims a short notice. About three years ago Dr Fayrer, of Calcutta (now Sir Joseph), in a letter to the *Medical Times and Gazette*, directed attention to a secret remedy called Goa-powder, sold by the chemists of Calcutta and Bombay, and used by the natives for the cure of herpes circinnatus, chloasma (pityriasis versicolor), and intertrigo, and which he had found speedily and certainly effective — in both respects far beyond any other remedy known to him. This letter elicited, a few months afterwards, a thoroughly well-informed communication from Dr Lima, of Brazil, who, besides corroborating the therapeutic virtues of the remedy, traced the material from its place of production to its place of sale. Dr Lima showed that this substance had for a long period been exported from the province of Bahia, formerly a Portuguese colony, and from thence to Goa in Hindustan, then and now a Portuguese possession. From Goa it is commercially distributed throughout India. In Brazil it is called araroba powder, signifying tawny-coloured. Under the several names of Goa-powder, Bahia powder, and Araroba powder, it has long been largely employed in South America, India, China, and the Malay Archipelago for the treatment of parasitic diseases of the skin, particularly ringworm. But until the recent researches of Dr Balmanno Squire it has not, so far as I am aware, been used in Europe, and the first recognition and demonstration of its extraordinary properties in this country are fairly due to this gentleman.

[1] At the present date, 7th June, all the cases referred to continue well. And to the list there may now be added two cases which have come under treatment since the reading of my paper. A lady, aged above 65 years, has for "a very long time" had a large patch of psoriasis, limited to the left temple, and resisting a variety of treatment. Notwithstanding the age of the patient and the situation of the disease, I used the remedy in the customary full strength, and with no bad effects. The cure has been rapid—unusually so—and seems to be complete. The other case is that of a healthy young woman, aged 26 years, whose arms from the back of hands to the elbows, and legs from front of instep to the knees, have been for four years affected with patches of the size of a pea to that of a shilling. This case has been only a fortnight under treatment; but, from present appearances, there will certainly be a speedy cure.

Goa-powder is derived from the medulla or pith of the stem and branches of a tree belonging to the leguminosæ, there being several species of the araroba, which, like the well-known Brazil-wood, are employed for dyeing purposes. The powder, while sold as a secret remedy, fetched a high price, being dispensed in Bombay at 4s. 6d. per ounce, and, little more than a year ago, when brought to London as a curiosity, its retail price was 10s. an ounce.

Dr Squire had his attention directed to the powder about eighteen months ago by a gentleman affected with psoriasis, who stated that he had often when in China cured himself of a patch here and there through the use of a powder employed in that country for the treatment of ringworm. This gentleman demonstrated upon himself the effects of the powder with a result so surprising that Dr Squire's interest was strongly aroused, and he immediately investigated the character and action of the remedy. He was soon convinced of the thorough efficiency of the drug in a field as yet unexplored by any other observer, and, after testing separately the various chemical constituents, he ascertained conclusively that all the healing virtues belonged to one of these, viz., chrysophanic acid.

Chrysophanic acid is treated of very shortly in modern works on chemistry, but its first recognition as an article of the materia medica is, so far as I am aware, to be found in a note attached to the latest edition of Squire's *Supplement for the British Pharmacopœia.* Its therapeutic qualities as the active agent in the treatment of skin diseases are certainly noticed for the first time in the *British Medical Journal* of November 1876 by Dr B. Squire. That gentleman has, on several occasions since, strongly expressed his opinion of its remarkable qualities, and in February last he embodied in a pamphlet of 100 pages (Churchill) the more notable facts of the history of the drug, together with his experience of its effects, and his recommendation as to the best mode of its employment. To that monograph I refer for fuller details on some points that I am treating of only in a discursive manner.

Chrysophanic acid exists as a more or less important constituent of several vegetable substances. It has been found in the common dock-lichen, in the cathartin of senna, and in the medullary rays of Indian rhubarb, being known in the latter case under the names *rhœin* or *rheic* acid. But for commercial purposes it has as yet only been obtained from Goa-powder. Dr Attfield, in a very careful investigation, has shown that chrysophanic acid forms upwards of eighty per cent. of the Goa-powder, and he conclusively demonstrated the chemical identity of the Goa, the Bahia, and the Araroba powder.

The high price of chrysophanic acid constituted a great hindrance to the employment of the drug, but within the last twelve months the cost has fallen from 10s. to 5s. per oz., and the probability is that, with increasing demand, the cost will be still further reduced.

Dr Squire recommends that chrysophanic acid should be used in the form of ointment, for which the following formula gives such a full strength preparation as I have accustomed myself to employ: ℞ Chrysophanic acid ʒij., lard ℥j. Digest the acid in the lard at the temperature of boiling water for half-an-hour, stirring constantly. When "set," mix with pestle and mortar.

This strength of ointment will be found generally suitable, but it may, of course, be varied, and reduced in strength to suit cases where the skin is extremely sensitive.[1] To prevent disagreeable results from over-action of the remedy, as well as to ensure that it is not employed in a careless or half-hearted manner, I recommend that personal attention of the medical man should be given during the first week of treatment, and that the case should be seen from time to time while the treatment is continued. The details, if carefully supervised in the early stage, will ensure a progress within a few days that otherwise will not be made in several weeks. These details, together with the accidents of treatment and the *modus operandi* of the remedy, will be best understood by portraying a typical case. The patches of psoriasis are first rubbed well with a piece of stout blotting-paper or common rag, moistened with benzole, the object of which is to dissolve and remove that natural greasiness of the skin which, like a film, opposes the ready penetration of the skin by the specific. I believe that benzole—a tar product—has also some specific action, and is therefore otherwise a useful adjunct. This preliminary application of benzole facilitates the next application, viz., hot water freely used with soap, the object being that of softening the layers and fragments of epidermic scales. The removal of the scales is a matter of prime importance, and must be effected whether by scraping with a blunt knife, or by scratching and picking with the finger-nails. It is only when the film of epidermic scales are removed that the skin proper can be fairly attacked, and I have not been deterred by the starting of a little blood from pushing to an extreme degree this scraping and scratching operation. The ointment is now rubbed in very perseveringly for several minutes at a time with the tips of the fingers. As the ointment is a dye, and will stain for some days the fingers and nails, I occasionally prevent that disagreeable accident by recommending the use of indiarubber finger-stools such as are frequently employed by photographers. These three stages of local treatment, viz., the wiping with benzole to remove

[1] In the comments which followed the reading of my paper, it was observed by Dr Service—assistant-surgeon under Dr M'Call Anderson in the skin wards and dispensary of the Western Infirmary—that successful use was being made of the new remedy in these institutions; but they thought that Dr Squire's formula, as adopted by me, was much too strong. They considered 10 grains to the ounce of ointment as sufficient. The average strength now employed by Dr Squire is 80 grains to the ounce; but I have, as yet, found no reason to alter the formula, which I have hitherto found to be invariably and speedily effective, with no necessarily attendant evil consequences.

grease, the thorough soaking of thickened patches of skin with hot fomentations, washing with soap, diligent scraping away of epidermic *debris*, and the patient rubbing in of the ointment, may be employed three times a day if the patient can command the necessary time and facilities. There is no question that the more frequent the application the more rapidly does the disease come under the action of the curative agent. But under ordinary circumstances a morning and evening application seem to give a sufficiently satisfactory result.

Within two or three days there comes on a dusky erythematous redness of the skin, partly the effects of the dye and partly the stimulant and irritant effect of the drug. As its action increases there occurs an inflammatory thickening of the skin in some cases and in particular situations, causing œdema. Thus, the face becomes puffy and the eyelids tumid. It also occasionally happens that stiffness from distention of the skin, with smart sensations of burning and tingling, will be felt all over the affected surface, but seldom to that extent to be positively distressing. In two instances I have known several boils of trifling severity to be produced on the dorsal aspect of the body, where the skin is naturally coarse, and prone to take on over-action; and in the case of Mr. G. I learn that he experienced a full crop of boils, and was, he says, for several days and nights "kept in a very lively condition." Where the hair of the scalp is white or light gray, there will occur a phenomenon against which it is well to prepare the patient. In the case of my friend Mr G, whose hair is naturally white, it rapidly assumed "a bright canary" colour, ending in "a fine purple," and in the change passing through shades and gradations that would excite the envy and aspirations of a decorative house-painter. Indeed he found himself so much "the admired of all observers," and so much the source of wit to the London street *gamins*, that he could only venture a "constitutional" walk after nightfall, while his day life for several weeks was passed in a Hansom-cab, as he travelled to and from his numerous appointments with Dr S. I have not, however, observed this unpleasant accompaniment of the treatment to have occurred in other cases where the hair was of the darker shades. But it is satisfactory to know that, however the hair or skin or nails may be stained, in every instance the natural colour is soon restored after discontinuing the treatment—often within a few days. This restoration does not occur, however, in the case of the underclothing, sheets, etc., when soiled by the ointment, and the patient should be warned, that only articles that are of little value, or in which colour is of little moment, should be exposed to contact with the remedy.[1] One farther warning exhausts all that need be mentioned. A properly secured nightcap will prevent the pillow from getting smeared, and a possible transfer of the substance to the eyelids, which would in

[1] I have just learned that repeated bleaching has recovered articles supposed to have been hopelessly discoloured.

such a case certainly become swollen. And if the patient is in the practice of rubbing his eyes awake at early morning, he will do well to sleep in gloves.

After a few days' active use of the ointment the diseased patches of skin cease to shed scales—a few days more, and they become smooth and polished, surpassing in these conditions the surrounding healthy integument—and still a few days more, and then a remarkable change occurs. The affected spots become white—almost unnaturally white, in this respect contrasting very markedly with the surrounding healthy skin, which meanwhile retains the dingy nut-brown staining effect of the dye. If there is now no rough marginal line indicating the original outline of the diseased patch, and if no more scales are being shed, or capable of being picked off or scratched away, then the application of the ointment may be discontinued. Two or three applications of the benzole and of soap and water will within a few days leave the skin free from any trace of the disease. It becomes, indeed, impossible to trace the outlines of where the patches of psoriasis were situated, so completely does the skin resume its original integrity of aspect and of function.

And here there would seem to be an interesting question opened for consideration, but to which I will now do little more than make a reference, and that is the *modus operandi* of the remedy. Dr Squire has some shrewd observations on this point. Most irritants of the skin have very different kinds of effects. Thus the vesicle or pustule of croton oil and tartar emetic, the vesication or erythematous irritation of cantharides and mustard, although differing so widely in their special irritation, seem all to act chiefly on the surface only of the skin proper, and do not affect the deeper structures. But the action of chrysophanic acid penetrates deeply, and affects the subcutaneous areolar tissue with less of surface irritation than these or most other rubefacients. The "quality" of the irritation it produces seems to be different, and to be specific. It seems to affect more or less the entire thickness of the skin, in this respect contrasting very materially with the ordinary local remedies for skin diseases, which have for the most part a very superficial action. May not a full consideration of its action in ringworm and other parasitic diseases lead to the conclusion that psoriasis—like pityriasis versicolor, so long and so lately held to be constitutional—should also be classed among parasitic affections of the skin?

And now comes another important question. Is the cure which I have shown to be so speedily and so certainly effected a permanent cure? The time which has elapsed is too short to admit of answering in the affirmative. But it is scarcely reasonable to expect as much, or to suppose that the same conditions which originated the ailment may not again combine. It ought to be sufficiently satisfactory if the remedy is as reliable as I have shown it to be. And if it will arrest and stamp out a relapse, then its importance and value remain as great as can fairly be hoped for.

I think that two of my cases will throw some light on this latter point. In one case, that of Master C., there was, as I have already stated, an element of disappointment. On 10th December I thought him completely cured, and discontinued treatment. I did not re-examine him until 1st February, when I was startled by detecting on close inspection a number of suspicious white spots like an efflorescence, consisting of epidermic scales. They were of size varying from a pin-head to a mustard-seed. Being uncertain how far they indicated a reaction from previous irritation resulting from strong applications, or a relapse, I did nothing for a week, when I found that they had increased in size, being in some instances of the diameter of a pea. They resembled dried spatterings of lime, and when scraped the skin was found red underneath. There was very clearly a relapse. I now resolved on an experiment I had for some time contemplated, and applied to the right arm and the same side of trunk a solution of chrysophanic acid in liquor potassæ, painting each spot with a camel-hair pencil. To the other side of trunk and the other arm I applied—for reasons to be afterwards given—a watery paste of alizarin,[1] causing it to be thoroughly well rubbed into the skin. Within a week the specks of incipient psoriasis had entirely disappeared from both sides of body and from both arms *cum passibus æquis.* I have caused this patient to call upon me at weekly intervals since, and I have kept careful watch for the return of suspicious spots. A very few have appeared on the arms—none on the legs—and under the application of alizarin these spots have promptly given way. In this case, therefore, under two remedies—as I think of allied nature—an impending relapse has been promptly stamped out. Whether this result has been a coincidence or a consequence I will not at present say.

In another case, that of Miss E., there have appeared on the arms three small spots, each of the diameter of a pea. To these, as in isolated patches in a few other cases, I have applied chrysophanic acid mixed with collodion in the proportions of 20 grains of the first to a quarter of an ounce of the last. The spots are well rubbed with hot water and soap, then with strong alcohol, and lastly, painted with the collodion varnish, which instantly dries. At an interval of eight or ten hours the crust of varnish, which adheres very firmly, is rubbed briskly, and removed with a rag dipped in strong alcohol, after which a fresh coating of the varnish is applied. The patches so treated have undergone the same characteristic changes which follow the use of the remedy in the form of ointment, and little more than eight or ten days have sufficed for their removal. In this case of Miss E., a relapse, to all seeming, has been also promptly stamped out by recourse to the original remedy, although in a modified form of application.

The object of using in one case a solution of chrysophanic acid

1. The alizarin for this and other experiments was kindly presented to me by Messrs Arthur and Hinshaw, drysalters, Bothwell Street.

in liquor potassæ, and in another of a chrysophanic acid varnish, was to obviate the greatest drawback to an invaluable remedy—the only real obstacle, indeed, that may occasionally prevent it from being pushed to its utmost efficiency. While hopeful of relief from a great evil, there is a ready submission on the part of the sufferer to the disagreeable incidents which I have referred to as liable to occur in the course of treatment. But when the ailment has been substantially removed, and the patient has fairly got back to the comfort of clean linen, he naturally shrinks from returning to a practice which so surely disfigures his underclothing with ugly yellow stains, and frequently destroys them for farther use. He is, therefore, apt to submit to the insidious approach of a few spots in the hope that they will spontaneously subside—a hope no sensible medical man will encourage. It was, therefore, to me a desideratum to contrive such a modification in the manner of applying the remedy as will, on account of its cleanliness and the ease of its application, encourage the patient to resort to it without loss of time. Hitherto I have found this collodion varnish to answer admirably my intention, and have had no apologies to make for injured shirt-sleeves, cuffs, or neck-collars, and I will employ it more frequently in future, particularly in cases where the patches are few, the situations exposed, or the skin so sensitive as to suffer much from the active frictions which are necessary in the right application of the ointment.

In the pursuit of a hypothesis I have employed alizarin in two cases—first in that of Master C., as already described, and next in that of Master L. It will be recollected that in the latter case there existed a coarse thick patch about 2½ inches long on the front of left thigh which was not treated with chrysophanic acid. This was the worst patch of the three, and it was of the longest duration. To it I applied an ointment of alizarin made up in the strength of ʒij. to the ounce of lard, and used precisely under the same conditions as the chrysophanic-acid ointment. The treatment of this patch was commenced on 24th March, or about three weeks earlier than was pursued in the other patches. The effects were by no means so speedily apparent as is customary when chrysophanic acid is used, but the result has been equally effective, equally decided. There was less irritation under the use of alizarin—less intumescence of the integument, but there was much the same discolouring of the skin, and much the same white and smooth aspect of the patch as it emerged from the dusky red surface into a state of complete renovation. Was it the alizarin, or was it the combined action of benzole, of soap, and of hot water that effected the cure of this thick coarse patch of psoriasis? I am unwilling to dogmatize on a single case, and quite willing to admit that it gives no sufficient data for a decided opinion, but I may observe that it is corroborated by that of Master C., where a decided relapse affecting both arms and trunk of body was effectually arrested, and the disease removed from one side of body and from one arm, under the use of alizarin only, no benzole or other possible specific adjunct being employed upon that side. While, however, I am not more sanguine than such limited experience with alizarin should justify, I am nevertheless hopeful that the idea which I am now suggesting will lead directly or indirectly to a good practical result. For I am inclined to think that there is an analogy in the properties of alizarin and chrysophanic acid. So far they seem to be therapeutically isomeric, and my mind has been all the more inclined to admit the resemblance, because I have ascertained that they are chemically isomeric. I anticipate as possible and probable that alizarin may either prove a cheap substitute for chrysophanic acid, or that it may form a basis or a link in the artificial production of chrysophanic acid at a cheap cost.

It may help others to a conclusion if I exhibit the lines on which my mind has worked in the investigation of this problem. When I made a saturated solution of chrysophanic acid in liquor potassæ, viz., ʒss. to ℥ij., I observed during, and even after, the reaction a distinct odour such as characterizes some of the coal-tar products. I immediately connected this with the generally admitted therapeutic virtues of tar in skin diseases. It then occurred to me as possible that chrysophanic acid—the present wholesale cost of which is 80s. per lb.—might be manufactured cheaply from the coal-tar products. To this belief I was led by what I already know of the striking results of modern chemistry, which, when directed to these products, have produced the aniline colours, together with anthracene and alizarine. Alizarine, one of the organic vegetable pigments, was originally derived from madder, and cost 14s. per lb. It is now made from the coal-tar product anthracene at 1s. per lb., and the artificial preparation is in every essential of elementary composition, and of characteristic quality, identical with the original preparation derived from madder. Now there are several striking characteristics of alizarin which compare harmoniously with those of chrysophanic acid. Alizarine is also an acid—a weak acid, it is true, but quite entitled to be called alizarinic acid. Alizarine is convertible into anthracene when heated with zinc dust, and conversely anthracene, by another process, is convertible into alizarine. Chrysophanic acid is also converted into anthracene when heated with zinc dust, but the process has yet to be devised, as I think it will be, that will convert anthracene or alizarine into chrysophanic acid. Dissolved in potash, chrysophanic acid produces a fine deep purple or violet colour, identical with the reaction of alizarine and potash. And not to exhaust similitudes, the elementary formula for alizarine is identically that attributed to chrysophanic acid.[1]

[1] Alizarine is now produced in large quantities for commercial purposes from anthracene by heating the latter with nitric acid, by which it is converted into anthraquinone by oxidation, then acting on the latter with bromine to

It was only through demand, and stimulated by competition, that ultimately, and after long years, the process was devised and applied, by means of which alizarine is now artificially prepared, and its cost reduced from 14s. to 1s. per lb. It seems to me that demand will in time develop a process for the production of chrysophanic acid at a cost that will bring the remedy within the means of many individuals, and of various public institutions, where the present high price is a serious obstacle to its use.

I commenced this communication with references to the perplexities that beset the best-intended efforts of well-informed medical men conscientiously studious of the interests of their patients, and I have shown something of the distress occasioned by the sufferer from this loathsome disease, hitherto an *opprobrium medici*. I may conclude by illustrating how little, until the present moment, the physician could effect, even under circumstances where his own clamant personal interest, or his dearest feelings of sympathy were involved. A few days ago when discussing this subject with my friend Dr Littlejohn, he stated that very lately an eminent London surgeon, recently deceased, opened up a portion of his dress, and showed Dr Littlejohn the patches of psoriasis that, from the neck downward, bestrewed his body, while he added, with sad resignation, that these for twenty years had been "the bane of his existence." And Dr Littlejohn told me further of another recent instance, that of the darling child of one of the chiefest physicians of this country, but now deceased, who, in his own writings, has done much to throw light on the literature of this class of diseases. This gentleman's daughter received no relief from the vast experience and eminent skill of her accomplished father, or from that of the eminent *confrères* who contributed, with sympathizing diligence, their best services. As now instructed, it is my belief that there will never henceforth occur any similar instances of the insufficiency of medical resources in the treatment of psoriasis.

produce dibromanthraquinone (C14 H8 Br2). The latter is then fused with potash to obtain alizarine. We have the three stages of oxidation of alizarine, viz.:—

Anthracene, ...	C14 H8.
Anthraquinone, ...	C14 H8 O_2.
Alizarine, ...	C14 H8 O_4.

Which last is isomeric with chrysophanic acid, viz., C14 H8 O_4, and from all which I conclude that chrysophanic acid and alizarine are isomeric modifications.

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On Improvements in Gas Stoves. By JAMES ADAMS, M.D., L.R.C.S.E., F.F.P.S.G., Late Examiner in Chemistry, Fac. Phys. and Surg., Glasg., Late President of the Glasgow Medico-Chirurgical Society, &c., &c., &c.

[Read before the Society, March 17, 1880.]

TWENTY-FIVE years ago I read to the Glasgow Medical Society a communication on heating by gas, and exhibited a stove made to my design. In my belief that stove surpassed anything since open to public observation. But it was liable to drawbacks, which I then failed in overcoming, and I put aside my conception. I retained, nevertheless, the desire to see it realized, being sensible that I had made a substantial step in advance, and I have kept myself informed, and noted with interest all that has since been done in this connection. About eighteen months ago I re-entered with zest upon a practical investigation, feeling assured that the principles were sound that I had assumed for my guidance, and had practically embodied in my infant conception. I will now bring under your consideration a practical illustration of those principles.

Coal gas is not of uniform composition. It is a mixture of gases and of vapours, the number, qualities, and proportions of which vary in every locality where coal gas is manufactured for public use. Its most abundant constituents are compounds of carbon and hydrogen—the latter forming the bulk of the mixture. However carefully manufactured, impurities are always present, which, together with the gaseous waste products of combustion, should never be permitted to accumulate in the air of dwelling apartments. When coal gas is burned its constituents are transformed into other gases and vapours. On this point there is much popular ignorance. Because no smoke, and no marked odour may be perceptible, it is assumed that the combustion has left behind it nothing injurious. There is a hazy conception that perfect combustion means something like practical annihilation. But in point of fact, the invisible, mal-odorous, inflammable gas, has been merely transformed into invisible, non-odorous, non-inflammable gas. The carbon has united with oxygen of the atmosphere, and formed carbonic acid—a deadly poison if inhaled pure—and the hydrogen has united also with oxygen of the air, and formed watery vapour, whilst a large quantity of nitrogen has been set free from the air. But if combustion has not been perfect, there is formed, in addition to carbonic acid, another still more poisonous gas, called carbonic oxide. The common sense deduction is that gas stoves should be provided with flues to carry off the waste products of combustion into a chimney. It should scarcely be necessary to add that, where a stove is substituted for a grate as a means of heating an apartment, there should be retained the open chimney, or other means of proper ventilation which the open fire-place usually ensures.

The amount of light obtained by the combustion of coal gas varies according to the construction of the burner employed. The same gas which gives a pure yellow smoky flame when burned with a "rat tail" jet, is brilliantly white when a union jet is used, still brighter with a common argand, better still with a Sugg's argand; while in the latest street lamp introduced in Paris, and of which several are now under observation in this city—we seem to have reached a perfection that rivals the electric light. The production of heat—which as a force is identical with light—is quite as much influenced by the form of burner employed. And as the phenomena of light require to be considered with reference to the luminous rays, the chemical rays, the coloured rays, &c., so do the phenomena of heat require to be considered with reference to dark rays, visible rays, and other components or characteristics. Thus the several properties through which heat is communicated—viz., conduction, convection, and radiation—have each their special value and appropriate use, and ought to be carefully studied, so as to best ensure the maximum intensity of each property as well separately as in combination. A kettle over the fire is boiled partly by convected heat contained in the diffuse mass of flame and smoke ascending the chimney, and partly by radiant heat emitted by the solid incandescent coal underneath. But a leg of mutton placed in front of the same fire receives no heat whatever from *convection*, but is roasted exclusively by *radiant* heat emitted chiefly from the red-hot coal. A very small proportion only of radiant heat is emitted by the flame and smoke. By accurate observers it has been determined that about three-fourths of the heat from an open fire is convected heat, nearly all of which passes up the chimney, leaving only a fourth to be utilized as radiant heat. When coal gas is used as fuel, and the ordinary jet for lighting purposes employed, the convected heat generated amounts to 84 per cent., or five-sixths of the whole, and only 16 per cent., or about one-sixth, is given out as radiant heat. When the Bunsen burner, in any of its forms, is employed, the heat generated is nearly altogether that of convection, about 6 per cent. only consisting of radiant heat. The difference in the proportion of radiant and of convected heat, emitted by the same gas by a mere change in the method of combustion, depends on the presence of solid carbonaceous particles in the luminous flame. This question has been thoroughly worked out by Tyndall, and the results are recorded in his "Contributions to Molecular Physics in the domains of Radiant Heat." Using an apparatus of sensitive precision, he found the radiation from the luminous gas flame was fully two-and-a-half times that from the non-luminous flame. The degree of *force*—not the degrees of temperature—in the luminous flame was 30, and the radiation fell to a force of only 12 the instant the flame became non-luminous. But, by introducing solid matter, the radiation originating in the non-luminous flame became so intense that a spiral of platinum plunged in the flame brought up the index to a force equal to 200—that is, there was instantly generated an amount of radiant heat more than 6 times that from the luminous gas flame, and more than 30 times that of the non-luminous flame. "It is mainly," says Tyndall, "by convection that the hydrogen flame dispenses its heat; though its temperature is higher, its sparsely-scattered molecules are not able to cope in radiant energy with the solid carbon of the luminous flame. The same is true for the flame of the Bunsen burner. The moment the air (which destroys the solid carbon particles) mingles with the gas flame, the radiation falls considerably. Conversely, a gush of radiant heat accompanies the shutting out of the air, which deprives the gas flame of its luminosity. When, therefore, we introduce a platinum wire into a hydrogen flame, or carbon particles [or platinum, or various other solids] into a Bunsen flame, we obtain not only waves of a new period, *but also convert a large portion of the heat of convection into the heat of radiation.*"

To obtain in a practical form the means of converting the heat of convection into the heat of radiation has been the chief aim of my efforts for the improvement of gas stoves; and I will now give a short description of the method through which I accomplish my object.

I employ in gas heating stoves a burner consisting of a group of hollow perforated tubes or forms of fire-clay, supplied internally with a mixture of gas and air, which, passing through the perforations, burns on the outer surface. These fire-clay tubes are enclosed in a case or chamber, which prevents free access of air to their exteriors, where combustion is completed; but, by perforations, a small and suitable quantity of air is admitted, which ascends within and between the tubes, and ensures complete combustion that causes the fire-clay tubes to become brightly incandescant. Thus only the smallest practicable excess of unconsumed air is permitted to mix with the products of combustion. These products are led to a chimney by a flue of peculiar construction, in which they are detained until they have parted with all their available heat. Other channels or ducts lead currents of pure air along the heated walls of the flue channel; and the air so warmed is allowed to re-enter the room in which the stove is used. The walls of the air channels or ducts, and generally the casings of the stove, present an extensive surface, obtained by duplications of the casings, to take up the heat from the products of combustion traversing the flue channel, and consequently their surfaces do not become overheated. The air entering the stove is caused to pass in, at or near the top, and thus a supply free from dust is ensured, and draughts along the floor of the apartment are avoided. The warm air issuing from the stove is caused to pass over water contained in a trough, so formed that, by filling it more or less, the surface of water exposed to the warm air may be varied. Lastly—not to dwell on too many points—provision is made by which the risk of explosion is entirely obviated.

The time at my disposal will not admit of a detailed account of the arrangements by which the exact consumpt of gas necessary to produce the full efficiency of the stove is regulated with automatic precision, and by which the quantity of air necessary for perfect combustion is also supplied efficiently and automatically. I will only say on this head, that air is admitted to the combustion chamber by small apertures of carefully-regulated size and fixed number, corresponding to the designed supply of gas—that the air is projected in fine jets—and that it is so diffused that all, or nearly all, is brought into actual contact with the gas fuel, and in the right proportion. The stove when in use is always in efficient action, and when the full heating power is not desired the heat may be diminished precisely as the light of a gas jet is increased or diminished at pleasure.

Knowing that an enormous amount of the heat produced by gas combustion, whatever the method employed, consists of, or rather is lodged in, the molecules of gases and vapours that form the waste products, I deprecate the common practice of letting them go at large into the atmosphere, or sending them by the shortest cut up the chimney. But as a portion of the waste products consists of water in the condition of vapour which at a temperature under 212° F. will condense and trickle down as water—and that another portion consists of carbonic acid, which at the same temperature is more than half again heavier than air, and will not ascend the chimney unless in a heated and expanded condition—there is a necessity that I should let some of the heat go. As the result of numerous practical experiments, I have determined that the waste products should be passed into the chimney at a temperature not under 212° F., and not above 250° F., and nearer the latter than the former temperature. The average temperature under my arrangements exceeds 240° F. But these waste products have an initial temperature exceeding 2000° F., and to extract from them all the heat that is desirable, I cause them to traverse a flue of peculiar construction—a flue *sui generis.* It is of *great length*—consists of superimposed *horizontal* chambers—these chambers communicate by *contracted openings*—and the walls of the flue are fitted with *baffle-plates.* Each of these peculiarities has a separate action and marked influence; and the combined result is to cause the waste products to travel slowly at a mean temperature, and to force the gaseous molecules into that individual contact with the walls of the flue that is absolutely necessary before they can impart their contained heat. The heat transmitted by conduction through the flue walls to the outer surfaces of the flue is also diffused by conduction over a large surface area of duplicate casings. The pure air led over this extended surface is warmed to the temperature obtained under the most approved systems of warming by hot water or steam pipes, although, when desired, the heat may be greatly increased. The quantity of air warmed is very much beyond that of stoves of much greater external size. Thus a stove of ordinary construction has, we will assume, an external heating surface of 16 square feet. The same size externally, but made to my design, has, in addition to the external surface, an internal surface of 26 feet, making a total of 42 square feet—that is, a surface equal to 42 linear feet of a 4-inch hot steam pipe.

In my opening observations I stated that I had laid aside my conception of a gas stove many years ago, owing to serious drawbacks which I failed at the time to overcome. One of these was the danger of accidents by explosions. Such accidents occasionally take place on the incautious application of a light some little time after the gas has been turned on, or has otherwise been escaping and forming an explosive mixture of gas and air within the stove. The construction of my stove makes accident an impossibility. The entire "motor force" of the stove consisting of the furnace chamber, with all the subsidiary fittings for the admission and regulation of air, &c., are attached to a closely-fitting drawer or tray in the base of the stove, made capable of sliding out and in from the interior. When the drawer is withdrawn—as will always be unavoidable for lighting purposes—air is at the same time freely admitted, the stove is instantly ventilated, and any mixture of gas and air accidentally present is deprived of its explosive properties. Although a considerable interval may have elapsed between the turning on of the gas no explosion can occur. These arrangements ensure—1. That the stove is efficiently ventilated and free from an explosive accumulation of gas and air before a light can be possibly applied; 2. that the gas can only be ignited in the unconfined air of the apartment, openly, and therefore safely; 3. that the entire "motor," with its subsidiary mechanical arrangements and connections, is freely exposed to observation on every occasion that the stove is used, and therefore that any defective condition of the gasfittings or other working parts can be instantly recognized, and, if need be, remedied.

Several modifications of the construction of my hot-air stove have been designed. That which I now exhibit is a plain working model. It is for manufacturers to employ artistic devices for the outward forms, and to construct smaller or larger sizes to meet popular requirements. As the "motor force" is of the exceptional power of which I will presently give evidence, it is capable of being applied to a variety of uses for which high temperatures are required, such as cooking, laundry and tailors' stoves, conservatories, bakers' ovens, and, in short, nearly all the purposes for which coal itself is usually applied.

It has been pressed upon me to discuss here the important question of cooking, and to give some description of the modification of stoves I have designed in this connection. But that matter must be reserved for more special and full consideration than can be given on the present occasion. Hitherto I have been treating of the best method of *generating* heat within a stove by the combustion of coal gas, and the best method of *distributing* that heat *outside* the stove. For cooking and for analogous uses the principles of construction differ entirely. The objects I have aimed at in cooking stoves are—1. To prevent the distribution of heat *outside the stove;* 2. to ensure a more effective use of convected heat than hitherto; 3. to utilize the properties of pure radiant heat in a degree to which no existing gas stove can make pretension; 4. to devise cooking utensils specially applicable to gas stoves, or at least more suitable than any I find in ordinary use. That there is scope for improvements may be inferred from one illustration having reference to the conditions under which cooking operations are generally performed, and which will show that there is more matter for consideration in the subject than is dreamt of in the philosophy of stove manufacturers in general. At the recent Gas Exhibition at Greenock, Mr. Stewart, M.P., while heartily desirous to aid the movement, stated that, "from what he had experienced of food cooked by gas, *there was always a something left behind* which one would rather have been without." Some light may be thrown upon the cause of this peculiar undesirable "something" if we examine the arrangements made by the best stove makers. In roasting meat the burners are placed at the bottom of the oven, and the joint is suspended above, and then, in the words of the usual advertisement, the meat "is completely enveloped in an atmosphere of heated AIR, ... the joints when cooked have very much *the same appearance* as those done before an open fire, but they lose rather less in weight, are plump and full of gravy," &c.; and, finally, it is stated that, "in the roasting of a 6 lb. joint there is burned 30 cubic feet of gas." But is the meat roasted? Is it not rather what may be called gassed? It is not an atmosphere of heated *air* that envelopes the meat, but an atmosphere of hot waste gases, watery vapour, sulphur, tar, and other impurities, the products of gas combustion. Setting aside the gaseous impurities, may not the watery vapour alone have a share in producing this peculiar "something"? The combustion of 30 cubic feet of gas of average composition generates above 2 lbs. avoirdupois of pure water in the shape of steam vapour, and it is therefore easy to understand why the meat does not lose so much weight in the gassing process. It is already surrounded with *a watery atmosphere* that lessens evaporation. If the meat had been roasted before a clear fire, and a pan of water holding 2 lbs. had been boiled and evaporated into steam underneath the joint, the two processes would have been perfectly analogous, with the exception that in the gassing process there is mixed with the watery vapour some 200 or 300 cubic feet of the waste products of gas combustion. These are facts worthy of being pondered over, and so I leave them.

I will now cite some evidence of the efficiency of my hot-air stove. And here, if I confined myself to a bald statement, that so many units of heat are utilized in the combustion of so much gas, you would—at least, many would—be little the wiser. To appraise the statement you must know the value of the units, and have some standard or data for comparison. The standard in this country is that amount of heat which will raise the temperature of 1 lb. of water by one degree at 32° F. It may equally be reckoned in grains or ounces, grammes or litres, but 1 lb. is usually assumed. This standard is not conveniently applicable to determining the calorific force of a gas stove. The specific heat of air, its weight per lb. at every degree of temperature, the quantity of moisture it contains, the material of which the stove is composed, the shape in which it is fashioned, the absorbing power of the walls and other surroundings, &c., all form so many factors which must be taken into account. Then there is necessary a variety of formulæ, tables, and other data, close at elbow on every occasion, and on which are based arithmetical calculations, so intricate, tedious, and complicated, that very few individuals, although otherwise well-informed, can follow out perfectly the series of operations which go to the taking of a single test. So numerous are the fallacies to which the working of the rules are liable, that none of my chemist friends consider them practicable for ordinary use. But they all are satisfied that the method I adopt, although not perfectly accurate, is perfectly fair and perfectly sufficient in determining approximate values, and for ordinary purposes of comparison. I take the temperature of the air *delivered*, and deduct the initial temperature. I measure by an anemometer the quantity of air that *enters* the stove to be warmed. I multiply the cubic feet of air by the degrees of temperature it has *gained*, and call the product units of heat. Thus, 1000 cubic feet of air, we will assume,

This is of course not the scientific unit of heat –

enter the stove at 40° F., and leave it at 240° F. Deducting the 40° of initial heat, there remain 200°, which I multiply by 1000 cubic feet of air, and the product is 200,000 *units*. If the gas burned has been, say 5 cubic feet, I divide the gross product by 5, which gives a quotient of 40,000, and I say, that one cubic foot of gas has yielded 40,000 units of heat. The method is simple, easy to be practised by persons of ordinary intelligence, and it is sufficiently near the truth for all practical uses.*

But it is of greater importance to determine how far the units of heat produce the desired result, seeing that they may fail for want of concentration or right direction. Reckoning the units of a man's force, there were at Ulundi some 1200 British units, and some 20,000 Zulu units, and yet the lesser number proved the most effective. Gunpowder has great potential force, and a few grains will propel a pistol bullet through the pannel of a door, but it will not open or close the door. A child of 3 years old will open or close the door, but cannot force its hand through the pannel. A tallow candle contains the potential force of many units of heat, but burned as a candle will not boil a kettle. It is the manner in which a force is localized and applied that gives the true measure of force in its relation to our present subject; and I therefore place little value on a parade of units of heat, unless associated with evidence of the effect produced in the desired direction.

I will now show that, whether in the number of heat units generated, or in the production of the heating result derived, there is obtained in my hot-air stove a development of calorific force in gas stoves not hitherto approached. And this will be best done by comparison.

I select the best hot-air stove I have tested (and I have tested many that were not worth the trouble of a test), or that has been publicly tested, so far as I know. That to which I refer, and which I will call No. 1 stove, had much attention directed to it a few months ago. It was tested, at the instance of the manufacturer, by Mr. Joshua Horton, of this city, who has, you are aware, made gas matters a specialty, and who aided me some

* Taking the extremes of 32° and of 52° F. for initial temperatures (and it is difficult to suppose a wider latitude in actual use), and making two calculations, the first according to the usual formulæ, and the second according to my simple method, there is only a difference of less than 4 per cent.

18 months ago in various tentative experiments. The result of his tests upon No. 1 stove caused him to abandon in despair a gas stove he had himself contrived, and to express to me in private his opinion that I also should give up. This No. 1 stove was also tested by Mr. J. L. Bruce, architect, whose special knowledge of all pertaining to this subject is known to the Society. He certified that, with the exception of one of my rough working early models (which he had been privileged to examine while engaged in the investigation on the heating of Turkish Baths, an account of which is published in the *Transactions* of this Society), he had not seen a gas stove at all equal to that to which I am now referring. The certification of these gentlemen—excluding reference to my stove, which was not then open to public inspection—have been made public by the manufacturer as testimonials of merit, and my reference to these public facts is therefore legitimate. I afterwards, in conjunction with Mr. Bruce and with Mr. Harvie (the well-known ship lamp manufacturer, and also of large experience as a maker of stoves) tested this stove. Our tests were frequently repeated, and we are agreed. Mr. Bruce, in testing, prefers the use of some of the elaborate and complicated formulæ I have referred to, and the results he brings out, although not exactly in accord with mine, are so near as to make the difference of little importance. Substantially we are in accord.

Selecting the chief items from an elaborate series, I present them in the form of a table which will be easily understood.

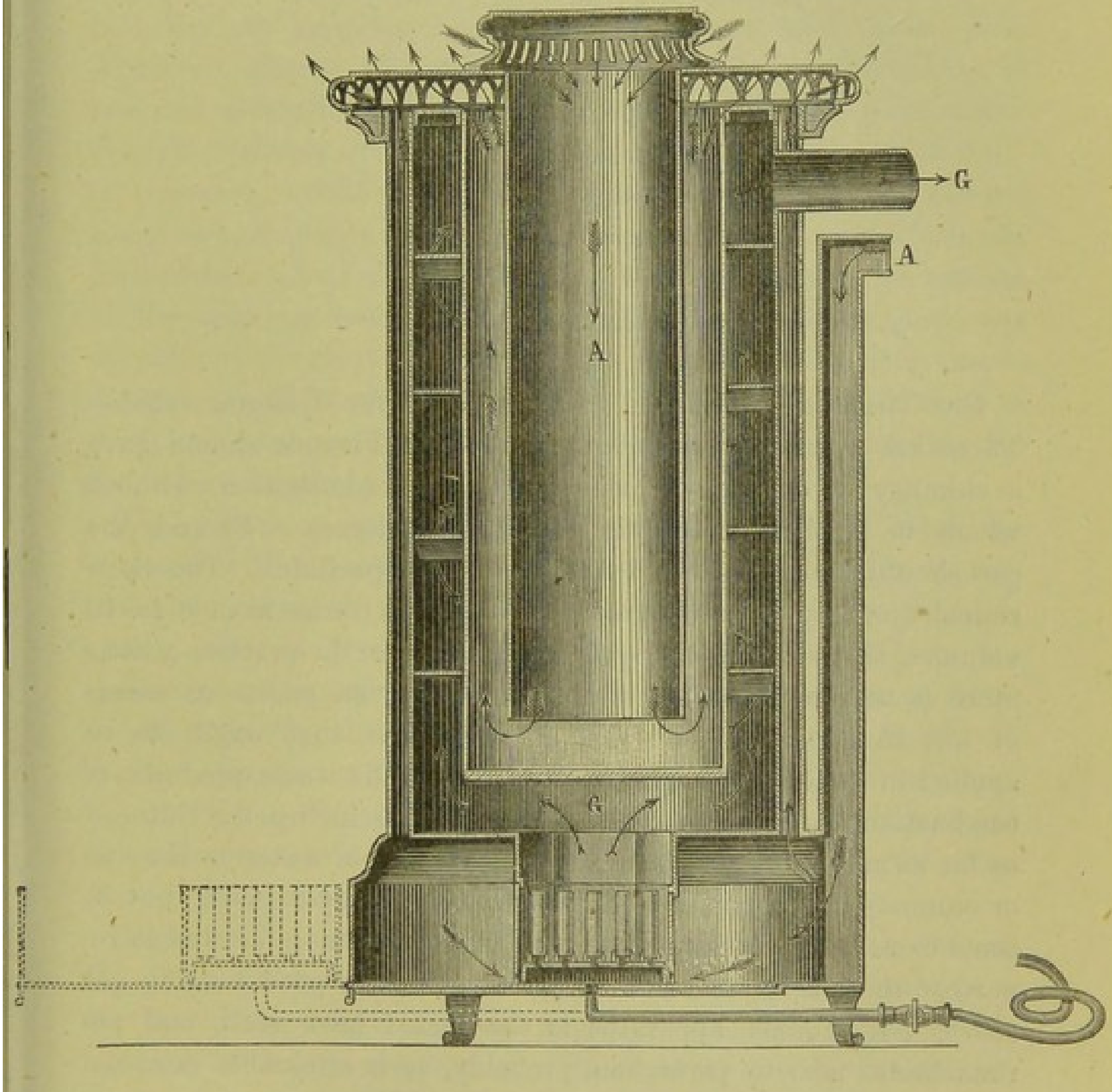
	Square Feet of Heating Surface.	Units of Heat utilized per Cub. Foot of Gas.	Temperature of Air warmed above Initial Heat.	Cubic Feet of Air warmed per Cub. Foot of Gas.	Temperature of Waste Products.
No. 1 Stove, presumably best in market, burning 10½ Cubic Feet of Gas per Hour, . . .	15	3658	62°F.	59	170°F.
Do. 13½ do., ...	,,	6336	132°F.	48	200°F.
No. 2 Stove, Dr. Adams' New Model, burning 12½ Cubic Feet per Hour,	42	51,300	180°F.	285	244°F.

In this table the units of heat utilized *by radiation and contact of air from the external surfaces of the two stoves are not calculated.* But as No. 2 has 3 feet additional external surface, and a much higher temperature throughout, any mode of calculating the additional heat shows a very large increase due to No. 2 stove. Similar tests made with cooking stoves made to my designs show, in comparison with others, a similar ratio of results.

It will be asked how I account for this vast difference. The explanation will be obvious when I remind you of two conditions already discussed—viz., *first*, the mode in which the heat is *distributed; second*, the quality of the heat that is *generated*. A Bunsen flame, you will recollect, is composed of a current of gaseous molecules which will only give up their heat to a stove if the walls are made big enough or the flue long enough. This has not been understood, and the practice is to let them escape into the atmosphere or up the chimney as speedily as possible. The heat contained in these molecules is further wasted by being diluted and cooled through the admission of large quantities of cold air, many times larger than is necessary for mere combustion. These defects are removed in a great measure when the same form of Bunsen burner employed in No. 1 stove is transferred to No. 2 stove. There is then effected an instant and great improvement. There is utilized 21[illegible],000 units of heat per cubic foot of gas, and there is heated 183 cubic feet of pure air 115° above the initial heat for every cubic foot of gas. This great advance over No. 1 stove is fairly attributable to the novel construction of the stove casings of No. 2, and is irrespective of the burner, because in both cases the same form of burner was employed. But this improvement does not sufficiently balance the defects inherent in any Bunsen burner hitherto employed when applied to a hot-air stove. The Bunsen is liable to "strike back," run down, and burn with a smoky flame—to be suddenly extinguished by strong currents caused by the opening or slamming of a door—by "a blow down" in the chimney, &c.; and it is incapable of generating in the useful form the quantity or quality of heat generated by the *Atmopyre* burner. The novel construction of No. 2 stove, with the Bunsen burner removed and the Atmopyre burner and new combustion chamber substituted, gives an additional enormous increase in the heat utilized, for there is now utilized 50,000 units per cubic foot of gas, and there is heated 285 cubic feet of air 180° above the initial heat per cubic foot of gas. In accounting for this additional extraordinary increase, I again remind you that the *quality* of the heat generated in the new combustion-chamber differs very greatly from that generated by the Bunsen. Instead of the merest per centage of radiant heat there is now generated a substantially large proportion, and that of the most intense energy. The Atmopyre burners become so vividly incandescent as to be nearly white hot, and the walls of the combustion-chamber become incandescent. This heat is not and cannot be carried off in currents, but is instantly distributed in straight lines. Instead of being loosely diffused in a cloudy current of vapour, it is concentrated and localized in a compact solid reservoir, which is continuously being replenished, and from which the radiant heat is drawn off through the absorbing walls of the furnace chamber. From the walls of the furnace chamber it is communicated to the walls of the pure air chamber, which is continuously traversed, and the walls bathed by large currents of fresh air receiving heat by actual contact with the walls, and the air thus warmed is rapidly delivered to the apartment through the wide open vomitories of the stove. While the Bunsen burner is, in like manner with an ordinary gas jet, a mere mechanical beak or outlet for delivering the fuel, and in no sense a source of heat in itself, but only effective in the production of convected heat, the Atmopyre, on the contrary, becomes in itself a source of heat, and is effective not only in generating intense radiant heat, but is powerfully effective also in producing convected heat. The Atmopyre burner in its chamber never strikes back, is not liable to be extinguished by strong currents, whether in the apartment or in the chimney, and cannot indeed be extinguished except by turning off the gas. And so intense is the heat accumulated in the incandescent Atmopyre, that for several minutes after being shut off the gas will re-ignite if again turned on.

In concluding this recapitulation of results of a practical investigation, I desire to say that only my chemist friends, who have at different stages aided me with their corroborative counsels, can adequately appreciate the laborious details involved in giving practical form to theoretical conceptions; and to Mr. L. Mayer, of the Tharsis Co., to Professor Dittmar, to Dr. Wallace and Mr. Tatlock, the City Analysts, and others, I owe much obligation. To Mr. Harvie, ship lamp manufacturer, Broomielaw, who made my first stove 25 years ago, and who made the working model now before you, I now refer parties who may wish to have closer and more leisurely inspection, or more detailed information.

The accompanying drawing shows, in section, the chief peculiarities of one modification of a hot-air stove for warming apartments, warehouses, conservatories, &c. The hot gaseous current formed by the ignited gas in the furnace chamber is shown by forked darts traversing the series of chambers, and contracted openings, to its final exit by the flue leading into the chimney, and marked G. The course of the pure air which enters the stove to be warmed is indicated by feathered arrows. One supply enters



by a pipe at the back of the stove, the opening into the pipe being marked A, and passing down to the air chamber at the base of the stove, gives off a small supply to the furnace chamber for combustion. The main stream is seen to pass upwards between the outer duplicate casings and to be discharged at the top. A second supply enters at the summit of the stove, and following the course of the descending arrows till the current of air becoming heated at the bottom of the hanging tube is reversed and ascends, passing out at the top. The dotted lines at the base of the drawing represents the arrangement for preventing the possibility of explosion. The entire furnace chamber is drawn out on a sliding drawer, so that the gas is inaccessible, and cannot be lighted except openly in the unconfined air of the apartment, when it is no more liable to explosion than an ordinary gasalier.

Discussion.

Dr. Wallace, F.R.S.E., Gas Analyst for Glasgow, said—There are three requisites in a gas stove: First, it should have a chimney to carry away the products of combustion, without which it is objectionable in the highest degree. Second, the gas should be burned with as little air as possible. The theoretical quantity of air required to burn gas varies from 8 to 10 volumes, according to the quality of the gas: in practice a little more is necessary, but most gas stoves use an enormous excess of air, thus carrying up the chimney heat that ought to be applied in heating the apartment. Third, the waste products of combustion should be cooled down before passing up the chimney as far as may be safe to prevent condensation of water in the flue or chimney. I consider 240° F. about the proper point, but in some cases it might require to be a little higher. Viewed in regard to these three essential requirements in a good heating gas stove, Dr. Adams' apparatus is the best I have seen, and approaches as near to perfection, probably, as is attainable in actual practice. With regard to the water-vessel at the top of the stove, I do not see that it is necessary. The air is not drier in an apartment heated by a gas stove than it is in one warmed by an open fire, and the air in an inhabited room is more usually too humid than too dry. Of course, those who did not wish moist air had only to omit filling with water the trough running round the top of the stove, and thus the provision for moistening the air was no objection whatever to the stove itself. He congratulated Dr. Adams on having brought to pefection an apparatus of great public utility.

Professor Dittmar said that Dr. Adams' stove, to say the least of it, was founded throughout upon sound scientific thought, and this, taking gas stoves as gas stoves were going, was giving it high praise. To select a set of "Atmopyres" for the generation of the heat was the happiest choice that could have been made. The Atmopyre offered this great advantage, amongst others, that it retained within itself, and thus localized at the right place a considerable portion of the heat, which, in the case of a "Bunsen," for instance, would get wholly diffused throughout, and carried along with, the large stream of gases and vapours resulting from the combustion. And in Dr. Adams' stove a considerable percentage of the heat necessarily retained by these combustion gases was coaxed out of them by means of the system of circuitous canals through which they have to travel before they are allowed to reach the chimney, the heat abstracted assuming ultimately the form of a stream of *pure* hot air.

Dr. Adams so arranged matters that these gases enter the chimney with a temperature of about 250° F.; for this reason, amongst others, that the gases "must be kept above 212° F., at any rate, to prevent *condensation of steam.*" This, in the speaker's opinion, was a mistake. The steam in the gases, being largely diluted with incondensible gases, was at a mere fraction of an atmosphere's tension, and consequently would stand refrigeration to far less than 212° F. It would condense only when cooled down below that temperature at which water boils under that fraction of an atmosphere's pressure.

There was one other point in which he could not quite endorse Dr. Adams' views; he referred to the Doctor's mode of measuring the useful heat furnished by a gas stove. He (the speaker) believed in the old established unit of heat, and in his opinion the correct method for measuring the utilized heat was, to determine the volume of combustion gases going up the chimney in terms of unit of gas burned, from their temperature and composition to calculate the number of units of heat which they take away with them, and to deduct this quantity from the total number of heat-units evolved in the process of combustion. This latter quantity of course would, strictly speaking, have to be determined directly; it would be *calculated* only from a sufficiently complete analysis of the gas.

But, after all, the best proof of the pudding was by the eating; and a similar principle might with propriety be adopted in the case of gas stoves. He had had the privilege, some time ago, of assisting in such a practical testing of Dr. Adams' stove in the inventor's house. He found the stove to produce a comfortable heat in the room at a very small expenditure of gas. He was, in fact, so much delighted with the performance of the stove that he at once decided upon procuring one for his private laboratory, where, he felt sure, it would render excellent service, as indeed it was bound to do, wherever the attending to a fire was felt as a nuisance, and the absolute absence of smoke, dirt, and dust was a consideration.

In conclusion, the Professor congratulated Dr. Adams on the excellent hit he had made, and expressed the hope that, unlike the majority of inventors, he would derive from his invention the material benefit which he was so fully entitled to.

Mr. Harvie explained that there was a practical necessity for the high temperature of 250° F., or thereabout, in the products of combustion which passed into the chimney, for the creation of a sufficient draught in the chimney, irrespective of chemical theories or other considerations.

Mr. Buchan, Sanitary Engineer, commented on the high cost of gas as contrasted with ordinary fuel, and, after some remarks of a general nature by Mr. John Mayer, F.C.S., and Mr. G. W. Muir, Coalmaster:—

Mr. J. Hay, Heating Engineer, thanked Dr. Adams for his emphatic recognition of the need for a chimney for *all* gas stoves, in order to carry off the poisonous gases that were generated in the combustion of gas. This was the more welcome considering that, through ignorance or other causes, there had for many years past been a succession of inventions or forms of gas stoves unprovided with flues, and in which the chief claim usually put forward was that there was "no smell," so complete was the combustion and therefore no need for a flue. Such parties neglected, or were ignorant of, the fact that just because there was no smell, and because the combustion was complete, the poisonous carbonic acid that was formed was all the more deadly and insidious, and there was so much the greater reason that there should be a flue. He held that it was quite right that the gases of combustion should be passed into the chimney at a high temperature, because by being further cooled down, they would lose their ascending power. In illustration, he cited the experience gained many years ago in the case of the Arnott Stove, where at times the combustion came absolutely to a standstill from the want of sufficient power in the gases to ascend the chimney. He did not, however, agree with Dr. Adams in his mode of introducing the pure air, to be heated within the stove, from a high level, nor did he see any advantage in "torturing the air" by making it pass through these up and down channels. On the contrary, he thought it would be an improvement if the air was drawn directly from the level of the floor, and better still if from the outer atmosphere.

Professor Dittmar again rose, and directed attention to a point which, obvious as it was, had been left entirely unnoticed by the several speakers. The absolute weight of steam contained in a given quantum of a given air, of course (as Dr. Wallace correctly said) was independent of temperature; but it was different with the *relative* moistness of the air, namely, the ratio in it of the actual quantity of water present to the maximum quantity which *could* be present in the given volume at the given temperature. This ratio (which alone came into consideration, sanitarily speaking) did get less as the temperature rose; and consequently Dr. Adams, who, in his stove made provision for moistening the hot air furnished by it, was right; in principle at any rate.

Dr. Adams, in reply, said—The atmosphere was sometimes too dry and sometimes too moist to be wholesome. The water gutter, which formed part of the stove, was a provision through which individuals could suit their peculiarities of sensation, and at the same time it supplied to the physician a desideratum in the treatment of certain chest and throat diseases, and as such it had been cordially approved by the various eminent medical men who had considered and given counsel on this point. If, therefore, it was not necessary, nor an advantage from Dr. Wallace's point of view, it was at any rate no drawback, seeing that it could be used or not used at pleasure. With regard to Professor's Dittmar's opinion that rather too much heat was allowed to pass up the chimney, he might mention that this point had formed the subject of a special investigation by the late Dr. Ure, at the instance of Government. Certain Government officials, whose duties were performed in rooms heated by slow combustion stoves, suffered from ill health. Dr. Ure proved, that owing to the low temperature at which the products of combustion passed into the chimney, there was a want of ascensional force and that regurgitation of carbonic acid and carbonic oxide into the apartments took place. Setting aside the steam vapour, there was the carbonic acid, which was half again as heavy as air, and could not ascend unless greatly heated. Dr. Ure had therefore caused these stoves to be discarded as "poison vomiting coffers," and he recommended 300° F. as a proper and almost necessary temperature, wherever stoves were employed. He, Dr. Adams, had found practically that 240° was a sufficient mean temperature, and did not incline to go below that heat. With regard to the mode he had suggested for estimating units of heat in connection with gas stoves, he thought he had sufficiently explained that the method was only recommended as a rough-and-ready one, never designed to supplant the more elaborate and accurate scientific formulæ, but as an easy and nearly accurate mode accessible to individuals to whom scientific tables and formulæ were as a sealed book. Mr. Hay did not approve of the air entering the stove from a high stratum of the apartment, nor of it being led through any tortuous channel, and yet in both arrangements there was effected an improvement. In the report of the Commissioners appointed by the House of Commons to inquire into the best practical method of warming and ventilating dwelling-houses, the necessity is specially dwelt upon of keeping the floor of a room at a comparatively high temperature in order that the feet may not be constantly in a cold air bath, such as must necessarily be the case in our present chance arrangements for supplying air to a fire from the floor level; and this was the view held by all sanitary authorities, although the customary arrangements of dwellings stood in the way. His (Dr. Adams') method completely met the views of the Government Commission, and of the best principles of Hygiene. Besides preventing cold foot-bath currents of air, the arrangement in question ensured a supply of air for combustion which was free from the dust common to the low floor level, and thus the gas burners were not liable to be choked up, nor the walls of the flue, or of the stove, liable to be coated with impurities that in several ways hindered the efficient action of the stove. The tortuous channels for admitting pure air were in part necessary for the advantageous objects just specified, and in part were also designed to delay the current of air by causing it to pass over a surface of greater length, and thereby to enable it to get better heated. Mr. Buchan, in contrasting the cost of coal with that of gaseous fuel, had not taken into account that the mere first money cost of fuel was not the sum and end of the considerations that would determine every person's choice. There was the ready convenience of the gas, the absence of dust and dirt attendant on the use of coal, the saving of labour in lighting, and in the necessary watchful trimming attendance upon a coal fire. There was the consideration that it is not necessary to keep a gas stove burning continuously, or at its full power. On the contrary, it can be used for short intervals of the day as required, and regulated as to the time it is burned, the intensity of the heating force, or the steady maintenance of the heat it imparts, as easily as an ordinary jet of gas is controlled for illuminating purposes. From such points of view it would oftentimes be found that in the use of gaseous fuel there may be the truest economy.