Bronchi in Strümpell's work on *Medicine* (vol. i, p. 208) the following passage occurs: "As regards the pulse, one occasionally observes during inspiration a distinct diminution of the tension and height of the pulse wave—*pulsus paradoxus*." Finally, it occurs occasionally in healthy individuals (Riegel), and I find that it can generally be induced in the latter by the subject closing his mouth and nose and then rather forcibly endeavouring to draw in his breath. Fig. 2 shows a pulse tracing taken from a healthy house-surgeon illustrating this.

stenosis or forced inspiratory movement with the mouth and nostrils closed, it is much more marked, lasts longer, and acts visibly on the volume and rhythm of the pulse, producing the *pulsus paradoxus*.

It is probable, therefore, that increased work is thrown on the heart in cases of acute laryngitis, and when this important organ is weakened as a result of the pyrexia and of the virus of the disease it naturally tends to show more signs of failing as the disease progresses.

In some cases—in children with a flexible sternum in whom

Fig. 1.—Pulse tracing from a case of acute tonsillitis. Patient began to take a deep breath at the mark X.

Fig. 2.—Pulse tracing from a healthy adult. The nose and mouth being closed, a forcible attempt at inspiration was made between the two crosses (X).

The causes producing *pulsus paradoxus* in acute laryngitis cannot be the same as in mediastinal affections, where new-formed inflammatory tissue acts in some manner or other on the pericardium and impedes the action of the heart, or on the great vessels at the base of the heart by constricting their lumen during inspiration. Some other explanation must be sought for, and I think it is to be found in the great variations of the intrathoracic pressure on the heart and great vessels in the chest cavity.

Normally at the beginning of inspiration there is a slight amount of negative pressure produced in the chest, owing, of course, to the cavity of the latter being suddenly increased without the air being able to enter fast enough through the glottis to fill the expanding lung. This passes off before the act of inspiration is completed; but if the glottis be stenosed the amount of negative pressure so produced is greater and its duration much longer, extending in some cases to the end of inspiration. In these latter cases the effect on the pulse is plainly marked.

The manner in which the increased negative pressure in the chest determines the variation in the rhythm and volume of the pulse may be briefly summarised. The blood in the vessels of the body generally is subjected to the action of the constant positive pressure of the atmosphere, so when a partial vacuum is created in the thorax there is a tendency for the blood to be aspirated into the great vessels there. This aids greatly the venous circulation of the body, but at the same time must of necessity tend to hamper the flow of blood in the large arteries. The two results to some extent counteract each other normally. The thin-walled auricles are more affected by the aspirating action of the negative pressure than are the ventricles; and here again the venous flow is aided, so that the heart receives a plentiful supply of blood—in fact, the contents of all the great veins and arteries near the thorax tend to flow to the heart.

The ventricles receive the blood from the auricles, and, on contracting the right side of the heart forces its blood without impediment through the lungs to the left side. It is on the left ventricle that the full force of the extra work falls, for it has to overcome, not only the normal pressure in the arteries, but also the tendency of the blood in the large arteries to flow backwards in the direction of the negative pressure. In other words, the heart has to pump blood out of a vacuum into positive pressure. This negative pressure is normally only slight and transient in its effect on the blood flow, but in abnormal conditions, such as laryngeal

the recession of the chest is extreme—one cannot help wondering whether direct pressure on the heart from the retracted sternum does not enter into the causation of the feeble beats. In the first case I saw this suggested itself to my mind, the recession being extremely well marked and the pulse at the wrist imperceptible during inspiration.

REMARKS ON ACUTE INFLAMMATION, ACCOMPANIED BY GREAT PAIN IN THE HEAD AND EYES, AND BLEPHAROSPASM,

OCCURRING SOME HOURS AFTER WITNESSING ELECTRIC WELDING OPERATIONS:

ITS PREVENTION AND TREATMENT.¹

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IN view of the advancing utility of electric appliances in the working of iron for various purposes, and having last March opportunities which had never occurred to me before in my experience for seeing no fewer than five cases affected in the eyes by the glare of electric welding of iron, I propose to give a short history of those cases, and to draw attention to the need of extreme care in exposing, or rather protecting, the eyes by scientifically-constructed glasses or shields when in the presence of such a dangerous light.

The principle of this system of welding, known as the Benardo system, it may be as well to state, in passing, consists in the concentration of a great degree of heat upon a small area by means of an electric arc between the metal to be welded and a movable carbon rod conveying the current. It is well known that the temperature of the electric arc is the highest that can be produced artificially, exceeding that of any furnace. A piece of steel can thus be brought to welding heat, or made to run like solder.

The other system is named the Thomson-Houston system, and consists of merely causing a current of electricity to flow through two portions of the metal which are to be united, and owing to the high resistance of the imperfect junction the joint is raised to a welding temperature.

¹ Delivered at a meeting of the Yorkshire Branch of the British Medical Association, held at Sheffield.

I shall here take the opportunity of thanking Mr. J. Scott Anderson, of Sheffield, for the above description of the method of electric welding and many other useful hints of its future capabilities, which seem to cover a very wide area of applicability reached on the one extreme by repairing of flaws in a 20-ton shaft, and in the other a silver cream jug or a gold sleeve link.

On March 15th last I was hastily summoned at midnight by the celebrated engineer, Mr. Sampson Fox, to see a party of experts in electric engineering staying with him in Leeds, and who had earlier in the day been engaged for two and a-half hours in conducting experiments on a large scale at some important works in Birmingham. The first patient whom I was particularly asked to see was a German engineer, aged 50. I found him in bed suffering evidently very severe pain indeed in the head and eyes. He was entirely unable to open his eyes, the blepharospasm being so severe. But I was able to force open the lids and examine the eyes externally. I found the conjunctiva injected and the pupils contracted and apparently fixed. This had been going on for three hours. Cold applications which he was using did not appear to relieve him in the least. Accordingly I dropped a 10 per cent. solution of cocaine into the eye freely and ordered him to apply alum lotion, three grains to the ounce of rose water frequently, repeating the cocaine drops at intervals of an hour if he remained awake. This treatment gradually relieved the acuteness of the symptoms, and in about three hours he fell asleep, sleeping for five or six hours. The most remarkable point is that when he awoke he was able to open the eyes, the pain had gone, the injection of conjunctiva was much reduced, and he had absolutely no photophobia. His vision two hours afterwards, when I tested him, was perfect; the pupils and tension were normal. The ophthalmoscope revealed no abnormality of the fundus whatever. The second patient was Herr Krupp's manager, the great gun manufacturer, to whom I am greatly indebted for much scientific information upon this important and interesting subject. He also had witnessed these experiments earlier in the day in Birmingham, and observed that the workmen who were immediately engaged in the electric welding wore goggles, the composition and construction of which I shall refer to later on. The engineers had goggles also for their use, but minus the side protectors with which the workmen's glasses were provided. He also told me that five separate weldings of iron were proceeding at the same time in different directions, and that he felt the light pass by his glasses at an angle from a welding which he was not noticing, on account of the absence of the side protectors. I found that he had not suffered so acutely as the first case. Some photophobia had developed earlier in the evening and passed off. There was conjunctival redness and a tendency to contraction of the pupils, but the vision was unaffected. In the morning he was perfectly well without treatment, and I could observe no retinal changes. The third attack occurred in the case of an engineer from Cologne, aged 40. The symptoms in his case were subacute, between the first two in severity. He, too, almost recovered untreated by morning, and the veins and ophthalmoscopic appearances gave negative results, some conjunctival injection only remaining.

Forming part of this assembly of engineers were two from Glasgow, both of whom on a former occasion had suffered very acute symptoms from witnessing electric welding, although apparently well protected by specially constructed goggles but unprovided with side pieces. These gentlemen compared their symptoms to those of their German *contrères*, and they also got well rapidly under the free use of cocaine drops and cold applications—I believe suggested by Dr. Clucky, of Greenock. I must confess that I had never either seen or read of symptoms of this acute nature caused by electric welding such as the worst cases presented, and their occurrence, in the face of the possibilities of electrical advance, which is taking place by leaps and bounds, opened up whole fields of thought.

It is customary for the workmen in Sheffield, where the electric welding of iron plates is carried out, to hold shields—which I shall specially describe—in the left hand, so that no direct electric light can possibly strike the eye. These shield-glasses, both in England and Germany, are constructed upon the conviction that it is the chemical rays which are so

active in those special processes. The glass is therefore composed in German works of the deepest blue superimposed on red—the combination arranged in tone and tint to compose violet under the impact of this intense light, in fact to cut off the rays, which are known to be nearest the region of the most actively chemical rays of the spectrum of white light. This combination, I am informed, is so dark—or ought to be—that daylight can barely penetrate the glass, still the glare of the electric welding does so sufficiently for the workmen to see what they are doing. None of the workmen are reported to have suffered at all on this occasion, and probably none of the party would have done so had they had side pieces to their goggles.

In conversation with Mr. Scott Anderson's electrical engineer, I elicited some very interesting and valuable hints in regard to protecting the eyes during electric welding operations. After a large number of experiments, he finds that the best protector is in the form of a wooden shield about 12 inches by 10 with a short handle. Into the centre of this shield a series of five sheets of ruby glass are let into a rectangular opening about 5 inches by $3\frac{1}{2}$ set horizontally. This combination of five sheets of ruby glass he finds to be necessary, as sufficient density is not obtained by one plate glass of thickness equal to the five. The test to prove if the shield is perfect is to hold a lighted candle in front of the shield in an otherwise dark room; and if, through the ruby glass the flame is reduced to the appearance of a spark, such as is seen in a recently blown out candle, sufficient protection is obtained. This form has been found by experiment to be the best—better than any form of goggles or glasses—to be worn; and he tells me that my patients would never have been attacked had they been provided with such shields instead of the glasses which they wore. There is, further, an additional reason in recommending the use of the shield—the workman can hold it in the left hand, and with the right he directs the carbon rod; the shield protects the skin of the face and neck, which becomes tanned and peels off, just as the skin does when exposed to the rays of the sun—not from any heat, however, which is radiated, but evidently from the chemical rays. The Sheffield engineers do not think that the violet combination which the Germans recommend is so good as the compound ruby glasses in the shield. There are many points of interest which arise in these cases in the endeavour to explain the symptoms which I have recorded.

Probably the action is analogous in a minor degree to those instances in which the retina has been either temporarily or permanently damaged by the glare from a flash of lightning. If such severe symptoms may be caused by the chance striking of a small amount of such light, comparatively, into the periphery of the retina, how much more disastrous and acute the symptoms must necessarily be if by some accident the glasses or shields were broken or removed, and thereby exposing the eyes to the fierce glare unguarded. I am told by the engineer such is the convenience of this form of welding that it must rapidly come into constant use, especially where the electric light is already laid on, since this form of electric transmission can be readily utilised at a comparatively small cost. It is evident that with sufficient protection, such as I have described, no harm is found to occur, and I daresay that the eye may to a certain extent become tolerant of this light. It is the first occasion on which I have observed an eye disorder to be induced by electric welding or electric lighting of any kind. Other observers think that they are able to trace some forms of asthenopia and photophobia to this cause. But this is an extension of the subject which is outside the object of this special paper, and it is not my present intention to pursue it further than to notice this fact, observed by others, as being widely interesting when taken in connection with the more general question of electric illumination.

THE German Emperor has conferred the order of the Red Eagle, Fourth Class, on Professor Bernhard Fraenkel, of Berlin.

NEW DANISH PHARMACOPEIA.—The new edition of the Danish *Pharmacopœia*, which has been for some time in preparation, has recently been published. It will come in force on August 1st. The permanent Pharmacopœia Committee appointed by the King consists of Drs. Gram, Jørgensen, H. J. Möller, Steenbach, and Trier, with two others.