of that one tubule. There is an absence of the clear, homogeneous, serous-looking exudation which is often found in degenerative disease of the kidney.

The description which I have given of the histological appearances shows that a case of blackwater fever, diagnosed and observed by Dr. Kerr Cross, a physician of great experience in this disease, was a case of malaria. The parasites found are morphologically indistinguishable by me from those found in fatal cases of West African fever in which there were no blackwater symptoms.

The peculiar distribution and the small quantity of pigment seen in the liver and spleen I was at first disposed to consider as distinctive of blackwater fever, as they contrasted so much with the comparatively large black masses of pigment found in the previous West African cases, and, as I have already stated, they led me to believe, in the first instance, that there was no pigment present, but since I examined Dr. Kerr Cross's blackwater case I have examined the organs from a case of pernicious malarial fever from the neighbourhood of Sierra Leone, sent me by Major Wilson, R.A.M.C., which was not a blackwater case. Here the usual parasites were found in the brain in this case, but the small particles and scant quantity of pigment in the liver and spleen resembled the appearance presented by the blackwater case. Nor can any radical distinction be made in connection with the changes in the ordinary pernicious cases (not blackwater) in which considerable destruction and disintegration of the epithelium of the kidney tubules are present. The changes found in the kidney of the blackwater case were of an analogous nature. In both cases the epithelium had been acted on destructively by a toxin generated in the fever. In the blackwater case this toxin would appear to act with greater virulence, and, in some way not yet explained, this virulence seems to be increased by the presence of quinine in the blood. The spontaneous cure of blackwater fever, which often occurs, is very possibly associated with the virulence of the toxin, which acts destructively on the parasite. In that case the parasite would be killed by its own secretion.

In this case of blackwater fever the brain was the only organ in which the parasite was found; in this respect resembling the 5 cases of fatal Sierra Leone fever (none of which were blackwater fever) which I have examined. The presumption is very great that the parasite is the same. There is absolutely no evidence for the supposition that blackwater fever is due to a special form of parasite. It is much more likely that the same species of parasite varies in its poisonous power according to place and time, analogous to what is already known regarding the action of the parasite of tertian fever.

ADDITIONAL OBSERVATIONS ON THE FUNCTION OF THE SUPRARENAL GLAND.

By A. G. AULD, M.D.

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It may be well to recapitulate in a sentence or two previous results. In 1894 the observations I published in the *BRITISH MEDICAL JOURNAL* were briefly: (1) that many red corpuscles are destroyed in the gland; (2) that the medulla is the essential portion and secretes a specific substance which is visible in the veins. Shortly afterwards, Schäfer and Oliver announced that the pressure-raising constituent of the gland was only present in the medulla, and this would *prima facie* seem to confirm the view I brought forward. But while I have not the slightest reason to alter my original view of the medulla, it remains to be seen whether the discovery of an active principle by Schäfer and Oliver lends any support to it.¹

When engaged in a research on the chemical physiology of the gland in 1896-7, having special reference to this active principle, I submitted, in a short report to the Laboratories Committee, that this substance was not pyrocatechin, as Mühlmann and others had asserted, but that the reactions I obtained pointed to its alkaloidal nature.² Quite recently Dr. John J. Abel, of Johns Hopkins, in an elaborate paper, arrives at the same conclusion.³ He has separated the substance in the form of a benzoate. The base, or, in other words, the

active principle of the suprarenal, he has further isolated in the form of a light-grey powder whose percentage composition is expressed by the formula $C_{17}H_{19}NO_4$.

For the purpose of trying its effects on the blood pressure I used the aqueous extract of the medulla.⁴ The only point in these experiments I need bring forward is this: When the extract was injected into a vein which had been clamped as high up as practicable, on releasing the vein after a few minutes, a marked diminution of pressure was recorded as compared with that produced by injection into the free vein. In the case of the lower limb, six experiments on this point were made, both by clamping the limb itself in its upper part, and also the particular vein with the above result. Although not altogether free from disturbing factors, these experiments would indicate that the pressure-raising substance undergoes a process of destruction in the blood. I also found, as Schäfer pointed out, that extract and blood mixed *in vitro* and allowed to stand for some time, in no way impairs the activity of the substance, but of course this is no parallel with the case of circulating blood.

It is alleged by Schäfer that this active principle is beneficial, and is probably stored away in the muscles. But that it is destroyed, not only in the blood but in the organs, and more especially in the liver, receives unequivocal support in some remarkable experiments by P. Langlois. He found:

1. That maceration of suprarenal extract with hepatic tissue lessens its activity more so than maceration with any other organ.
2. That injection of a weak extract into the mesenteric vein remains without effect, although the same dose injected into the general circulation gives a notable elevation of pressure.
3. That in an animal under the influence of the capsular extract the blood of the hepatic vein is less rich in the active principle than the vein of any other organ.
4. That the suppression of the hepatic circulation causes a prolongation of the period of hypertension.⁵

Langlois's conclusions are that the liver chiefly, but also the blood and other organs, rapidly destroy this substance. And, if this be so, can it be regarded as the main constituent of the internal secretion?

RESULT OF EXTIRPATION OF THE GLAND.

For these experiments I used dogs and cats.⁶ One gland was first removed. The cats soon recovered, and remained perfectly well and active. In two months' time the remaining gland was removed from one cat; in another, the remaining gland was crushed and left *in situ*. The former cat died in twenty-four hours, and the latter on the second day. In the interval I had made some excisions of the gland in dogs at the Brown Institution, which, however, did not result successfully. Shortly afterwards Professor Rose Bradford informed me that it might be advisable to leave the animals for some time longer after excision of the first gland, as in the case of a dog, one of whose suprarenal glands he had extirpated, death occurred quite suddenly in about three months (or from two to three months) afterwards. I accordingly excised one of the glands in each of two fresh cats, but they were quite well and active five and a-half months afterwards. The other glands were then removed, and the animals died in about thirty-six hours after the operation. Similar results have been obtained by other observers after excision of both glands.

After the second gland is removed, the animal lies on its side in a state of intense weakness, has a peculiar drowsy look, and refuses to move. In one of the animals I happened to see death supervene, which was preceded by convulsions.

POST-MORTEM EXAMINATION.

First it may be remarked that no hypertrophy of the remaining capsules was apparent. Indeed, in one case, it seemed reduced in size; but in another there was a suspicion of enlargement, and the blood vessels round the organ seemed dilated. In all four animals two phenomena were very apparent: (1) A very great hypertrophy of the thymus gland, (2) a considerable enlargement of the spleen. One thymus measured 5 inches long, 1 inch broad, and $\frac{1}{2}$ inch thick. Pieces were hardened and subjected to microscopical examination. The most striking feature was an excessive vascularity of the medulla; otherwise the alveoli were enlarged

and the nuclei very prominent. The concentric corpuscles seemed unaltered.

REMARKS.

It is very difficult indeed to affirm what may be the precise significance of this hypertrophy of the thymus. It might be merely an ordinary result of disturbed blood relationships, such as is found under various circumstances, and in other lymphoid tissues. On the other hand there is no reason why it should not be specially compensatory to the loss of the suprarenal, and mean a performance of suprarenal work.⁷ If so, it would be instructive from one point of view, seeing that thymus extract is antagonistic, as regards its effects on blood pressure, to suprarenal extract. As regards the spleen its enlargement suggests increased hæmolytic function.

The main point to be decided is as to the nature of the active principle in the medulla. Is it a normal secretion or is it a poisonous product separated by the gland? Now, when it is considered that extirpation of the remaining gland was so rapidly succeeded by toxæmia and death, we certainly cannot argue from any other analogies that the mere deprivation of a normal secretion would explain this. Furthermore, when it is considered that the substance (if indeed it does pass into the circulation at all, as it has not been demonstrated in the suprarenal vein) produces its characteristic effects in such minute quantities, the likelihood is still less that its absence should be responsible for death in thirty-six hours. The results of Langlois's experiments, already mentioned, support this view. On the other hand, the symptoms certainly suggest the rapid accumulation of a toxic agent in the system. And it is not in the very least likely that this toxic agent should exist in the blood as a vaso-constrictor, as Schäfer actually found upon. As a result of its decomposition by the suprarenal gland, a vaso-constricting substance may well be formed having the properties of an alkaloidal poison. The pigmentation of Addison's disease and the chromogenic properties of the suprarenal further point to a constituent of (effete) hæmoglobin as the toxic agent.

In conclusion, the available evidence goes to show that the suprarenal acts by destroying deleterious substances, and also by furnishing a material to the blood. As the work seems to be done by the medulla, there is considerable ground for regarding the vaso-constricting substance as evidence of the former function. That a small quantity of this substance passes into the circulation with the specific secretion has not been proved, and, even if it did, its speedy destruction puts any special nutritive action out of the question. The auto-intoxication sufficiently explains the intense weakness and other symptoms which suprarenal treatment does not influence, as would be expected if absence of the vaso-constricting substance was the cause.

NOTES AND REFERENCES.

¹ BRITISH MEDICAL JOURNAL, May 5th and October 14th, 1894, and also July 4th, 1896. ² The details of this work I hope to publish elsewhere. ³ *Johns Hopkins Hospital Bulletin*, September-October, 1893. ⁴ I must here express my great indebtedness to Messrs. Burroughs, Wellcome, and Co., who kindly placed at my disposal an almost unlimited supply of sheep's suprarenals. ⁵ *Archiv. de Physiol.*, January, 1893, page 24. ⁶ The gland is easily and quickly removed by the lateral operation, and without any appreciable loss of blood. ⁷ Might I here make the suggestion of trying the effect of thymus feeding in Addison's disease?

FOUR UNUSUAL CASES OF HERNIA.

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THE surgeon who has to operate upon many cases of strangulated hernia finds his appreciation of the subject increase as his experience widens. The following cases not only illustrate some of the rarer varieties or complications of hernia, but also present several features of general interest.

CASE I. *Acquired Inguinal Hernia with Hour-glass Constriction of the Sac.*—T. B., aged 69, the subject of an old irreducible, acquired, inguinal hernia on the right side, was admitted into hospital on September 6th, 1896, after some 8 or 12 hours' vomiting and abdominal pain of sudden onset. The hernia, which contained much omentum and some bowel, was not tense, and had a marked impulse on coughing. The symptoms being very urgent, it was decided to explore the tumour, as its reduction even under the anæsthetic (ether) was impossible. The hernia proved to be one with hour-glass constriction of the sac. The upper compartment, which extended for a couple of inches below the external ring, was opened and no constriction at the rings was found. The bowel, however, was nipped by

a narrowing of the sac lower down, and could not be withdrawn until this constriction had been divided from above. The intestine was congested, but not otherwise damaged. In addition to this congested loop the sac contained a large mass of omentum adherent to its walls. Its pedicle as it traversed the upper sac was long, thin, and inconspicuous. The bowel was returned into the abdomen, the omentum removed, the sac ligatured at the external ring and taken away, and the operation concluded in the usual manner. Fourteen hours and a half later the patient died from rapidly-increasing embarrassment of respiration, which began soon after his recovery from the anæsthetic. At the necropsy there was found red hepatisation of the bases of both lungs, but no sign of bronchitis. There was, in addition, carcinoma of the pylorus and interstitial nephritis. There can be no doubt that the ether was the exciting cause of his death.

The pathology of hour-glass constriction of the sac receives unequal and sometimes scant notice in the textbooks. Mr. Birkett in Holmes's *System*¹ speaks of it only being met with in congenital inguinal hernia, and there can be little doubt that a considerable proportion of these cases are associated with a patent funicular process. The constriction in the body of the sac is said to mark the point where the tunica vaginalis propria funiculi meets the tunica vaginalis of the testis. But it is equally certain that hour-glass constriction of the sac is met with in acquired inguinal hernia. Thus, in my case, the sac stripped off the testis and its tunica vaginalis in quite the ordinary way, confirming the opinion as to its acquired character which the conspicuous position of the testis on the surface of the swelling had suggested. Recently Mr. Tubby² has recorded another case in which there can be little doubt (though it is not definitely stated) that the hernia was acquired. Here also the lower sac contained omentum, and had probably done so from the beginning, and strangulation seems to have resulted from a recent slipping through the constriction of a loop of intestine.

These two cases are best explained by Hunter's supposition that the original neck of the sac is pushed down from above.³ The tendency of the original neck to descend is facilitated not only by pressure from above, but also by the weight of the herniated omentum dragging it downwards. The two varieties differ also in another way. In the acquired hernia with hour-glass constriction due to downward displacement of the original neck of the sac, the inferior division has been occupied from the commencement, whilst the upper portion is a formation of a much later date. But in the congenital condition the upper sac has been the first receptacle of the extruded abdominal contents, and the escape of a portion of them into the lower chamber may be long delayed. Perhaps this is the explanation of a difference of external contour. Mr. Birkett points out that the hernial tumour as well as the sac is shaped like an hour glass, but in the case of T. B. the constriction in the sac could not have been detected easily, if at all, by its outward appearance; nor is such a peculiarity alluded to in Mr. Tubby's case; indeed, from the description it would appear to be certainly excluded.

CASE II. *Strangulation under a Band in an Inguinal Hernia.*—B. C., aged 61, had had a hernia for 12 years, for which he had worn a truss till three months before admission. Then increasing pain made him discard it, and in the interim the swelling gradually grew larger. On March 9th he was admitted after twenty-four hours vomiting associated with a painful increase in the size of the tumour. The rupture—a right inguinal one, and acquired—was as large as a melon, and not very tense, though on deep and firm pressure there was a sensation as if a buried portion were more resistant than the rest. There was a distinct impulse on coughing, and after a hot bath and taxis the hernia was considerably diminished in size, and the pain was eased; under these circumstances, and in the belief that the hernia was only obstructed, it was decided to wait, but the next day the local conditions were unchanged. The patient had had no sleep, and taxis again failed. With Mr. Ward's approval the hernial tumour was explored. Normal small intestine was found filling the upper part of a sacculated cavity, and in places slightly adherent to the wall. Behind this lay a portion of small intestine firmly adherent to the inner side of the sac, and from the mesentery belonging to this coil a thick strong band passed to an attachment on the outer side. Beneath this band a coil of intestine 12 inches long had slipped and become strangulated. Its colour was purple, but the constriction was not severe, and had left no marked indentation upon the bowel. The band was divided, the contents of the sac returned into the abdomen, and a radical cure completed. The patient was relieved, and made an excellent recovery.

Impulse on coughing, usually absent in strangulated hernia, was present in both the foregoing cases. Its absence is usually held to point to strangulation, and its presence may make a surgeon hesitate as to the propriety of operating, or lead him to suspect the existence of an obstruction elsewhere. It is well, perhaps, to be reminded occasionally that a portion of the contents of a hernia may be strangled and yet an impulse be communicated by the unaffected coils or omentum contained within the tumour.