(basing himself on the current routine laboratory methods of investigation) dogmatically asserted that a blood stain was in fact of human origin, could undoubtedly be cross-examined very severely and devastatingly and find himself unable to maintain the dogmatic assertion that the blood stain was exclusively of human origin. It is unlikely that he can go beyond classifying the stain as belonging to the primate group, i.e. the higher anthropoid apes such as the gorilla, the gibbon, the chimpanzee, the orang-outang; and monkeys, baboons and lemurs.

From Dr. Duncan Taylor's work it is clearly inaccurate and misleading even to report that a blood stain is of human or anthropoid origin. The term 'anthropoid' means resembling *anthropos* or Man; its use is, therefore, restricted to those tailless apes which resemble Man. Dr. Taylor's work exposes this vulgar error. Such inexactitude in terminology should be avoided rigorously as it reveals a lack of acquaintance either with the serological problems involved, or with zoological nomenclature.

Although it is clear from Dr. Duncan Taylor's survey that no simple practicable method is available for routine testing, the important fact emerges that where the gravity of the case warranted the trouble, the specific identity of a particular stain probably could be established. The technique required, however, is elaborate, expensive and time-consuming, and would mean that the appropriate primates would have to be inoculated in order to obtain the specific anti-sera for performing the tests.

Apart from the medico-legal importance of this kind of work, it obviously has considerable significance for anthropological and evolutionary studies. It emphasizes, moreover, the great care, knowledge, skill and caution needed to carry out this kind of investigation and to give expert evidence about it.

nie. 'n Deskundige getuie wat (deur homself te verlaat op die gebruiklike metodes van roetine laboratorium-ondersoek) dogmaties verklaar dat 'n bloedvlek in werklikheid van menslike oorsprong is, kan seer sekerlik baie drasties en verwoestend gekruisvra word, en bevind dat hy nie in staat is nie om die dogmatiese verklaring, dat die bloedvlek uitsluitlik van menslike oorsprong is, te handhaaf. Dit is onwaarskynlik dat hy verder sal kan gaan as om die vlek te bestempel as behorende tot die primaatgroep, d.w.s. die hoër mensape soos die gorilla, die gibbon, die sjimpansee, die orang-oetang; en ape, bobbejane en lemurs.

Volgens dr. Duncan Taylor se werk is dit duidelik foutief en misleidend om selfs te rapporteer dat 'n bloedvlek van menslike of antropoiëde oorsprong is. Die uitdrukking ‚antropoiëde' beteken lykende na *anthropos* of die mens, en die gebruik daarvan is derhalwe beperk tot daardie stertlose ape wat na die mens lyk. Dr. Taylor se werk stel hierdie growwe fout aan die kaak. Sulke onnoukeurigheid van terminologie moet streng vermy word, want dit verraai gebrek aan kennis van òf die betrokke serologiese probleme òf die soölogiese benaming.

Hoewel dit duidelik uit dr. Duncan Taylor se oorsig blyk dat daar geen eenvoudige uitvoerbare metode vir roetine-toetsing is nie, tree die belangrike feit te voorskyn dat in 'n geval waar die erns van die saak die moeite regverdig, die spesifieke identiteit van 'n sekere vlek moontlik bepaal kan word. Die vereiste tegniek is egter uitvoerig, duur en tydrowend, en sal beteken dat die gepaste primate ingeënt sal moet word, ten einde die besondere anti-serums om die toetse mee uit te voer, te verkry.

Benewens die medies-geregtelike belangrikheid van hierdie soort werk, het dit klaarblyklik aansienlike betekenis in verband met antropologiese en evolusionêre studies. Bowendien benadruk dit die groot sorg, kennis, bedrewenheid en versigtigheid wat nodig is om hierdie soort van ondersoek uit te voer en deskundige getuienis daaroor af te lê.

THE GENERAL PRACTITIONER AND THE GENERAL ADAPTATION SYNDROME*

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'Sweet are the uses of adversity
Which, like the toad, ugly and venomous,
Wears yet a precious jewel in his head.'[1]

Selye's theories of adaptation[2] will certainly have one effect on the general practitioners: Cortisone and ACTH will be prescribed freely. It would be a pity if these exciting new theories made no further impact on general practice. From his unique vantage point over so much of his patients' life span, the general practitioner is ideally placed to assess any academic theories of adaptation. Within the observation of every practitioner, thousands of individuals fight out the collection of struggles which constitute their lives. Fate sometimes presents such a struggle under the conditions of a clean-cut experiment; these occasional cases constitute an ideal test for the truth of any theory.

I propose to present a few such examples sorted from my own experience. This sort of clinical experience, on the whole, is easily explained in terms of Selye's theories and indeed these brilliant theories have illuminated retrospectively much that was dark and puzzling in the clinical scene. However, the clinical evidence is at times absolutely at variance with some of the laboratory theories. Where these clash I have preferred to believe the clinical evidence.

These theories have a further value to the practitioner: he may actually base his treatment on them. The results of such 'Heuristic' experiments will occasionally have outstanding value as confirmation of the theory itself and

* The References will be published at the end of the concluding part of this article.

the practitioner may sometimes be rewarded with a gratifying cure. Admittedly unconfirmed theories are not ideal therapeutic weapons but they are superior to mere placebo treatment.

The General Adaptation Syndrome (G.A.S.) has met with a cool reception from a minority (notably Pickering[3]), but within the limited scope of this article I shall attempt no criticism of the main facts and theories relating to adaptation. I present them herewith and propose to accept them tentatively, so that their clinical implications may be tested:

1. *Adaptation to mild stimuli* is continually occurring. The body is adapting itself to the products of its own metabolism (internal adaptation). The body also adapts itself to the thousand petty shocks of every-day existence (external adaptation). Claude Bernard[4] was the first to point out that all such adaptation has as its 'aim' the constancy of the internal environment or *milieu interieure*. The body struggles to maintain not merely its biochemical norms; in the face of adverse factors, extraordinary efforts are made to preserve the norms of histological pattern, of gross anatomical structure and of such biomechanical values as arterial blood pressure. It is important to realize these vast implications of Claude Bernard's concept, for Selye has shown that exhaustion of the power of adaptation in any one field will affect the power to adapt in a totally different field.[5, 6]

2. Selye's work is concerned with *adaptation to gross stimuli*. He calls such stimuli stressors. (Stress is the *state* produced by a stressor.) The great merit of his work is that he showed that there is the same reaction to every sort of unfamiliar stressor. This is non-specific adaptation. However, when the body has learned to cope with a particular stressor it does so by means of a *specific adaptation*. Non-specific adaptation is quite dependent on the adrenal cortex. Thus a healthy man may be well adapted to some specific stressor such as intense cold. If he now loses his adrenal cortex he can still cope with the cold and he does so in virtue of a specific adaptation which he had previously acquired. But if such an adrenalectomized man is suddenly presented with a completely new stressor, such as an excess of heat, he will die. Alternatively, he would have lived if he had retained the use of his adrenal cortex, which would have furnished him with the material for non-specific adaptation. This latter adaptation tides over the dangerous gap before the body has learned specific adaptation to a particular stressor.

3. Two different hormones are successively secreted by the Adrenal Cortex to effect *non-specific adaptation*: First, gluco-corticoids of which Cortisone is the chief available type; gluco-corticoids are so called because (among many other actions) they have the property of transforming proteins into glucose. The second hormone is of the mineralo-corticoid group and its chief available type is desoxycorticosterone acetate (DOCA). One of the properties of mineralo-corticoids is to control the retention of minerals such as sodium. Both these types of hormone are secreted from the adrenal through the agency of anterior pituitary hormones. The adreno-corticotrophic hormone of the pituitary (ACTH) is responsible for the release of Cortisone but the anterior pituitary hormone which causes the release of DOCA has not yet been identified with certainty. An unknown factor causes the first stage of the General Adaptation Syndrome (G.A.S.); Cortisone causes the second stage and DOCA the third stage. (Often for the sake of brevity in this paper, Cortisone must be taken to imply several gluco-corticoids including, and with a similar action to, Cortisone; DOCA implies several mineralo-corticoids, including and with a similar action to DOCA). Each of these three causative factors is mutually inhibitory to the other. It is as though the actors in each successive scene of a play had not only to act their own role, but also to eject from the scene those actors who came before them, as well as those destined to succeed them in the later scene. The importance of these mutual antagonisms will appear later.

4. There are three stages in the G.A.S.:

(a) *The Stage of Onset, Shock or 'Alarm Reaction'*. Its features are low blood pressure, low temperature, leucopenia, low blood protein, low blood chloride, liability to gastro-duodenal ulceration and extravasation of plasma from the capillaries with resulting haemoconcentration. Selye has called this the stage of damage.[6] However, it is unthinkable that such a clearly defined pattern could represent anything but a definite and organized plan for the body's welfare. This stage is probably the stage of mobilization of the body's defences; as such, we can understand that it may disrupt the smooth working of the body's normal mechanisms. Sometimes this large-scale interruption may prove fatal. In this respect events will have followed a well-established course and I drew attention to this law in a previous paper[7]:—'All defensive mechanisms can become exaggerated until their offensive exceeds their defensive value.' This law will be found to apply to both the DOCA and to the Cortisone phase of the G.A.S.

(b) The next stage is that of *Resistance*. It is mediated by gluco-corticoids and is characterized by a rise in all those values, which fell in the Alarm Reaction and by a healing of alimentary tract ulcers. There is an abrupt fall of eosinophils. Next comes the stage of healing fibrosis; it is mediated by mineralo-corticoids which cause the growth of fibrous tissue around wounds and inflamed areas (locally conditioned target areas of Selye). Selye claims to have produced rheumatoid arthritis experimentally by this mechanism[8]; he injected an irritant around the joint. The general effect of the irritant was to induce a G.A.S. with production of mineralo-corticoid; the latter produced its fibroblastic effect locally upon the joint, because this had been 'conditioned' by the irritant around it; simultaneous injection of Cortisone prevented the development of this experimental rheumatoid arthritis. 'Conditioning' of the pituitary by a high protein diet led to increased production of mineralo-corticotrophic factor during the course of the Alarm Reaction. 'Conditioning' of the kidney by excess of dietary salt causes the kidney to respond to DOCA by the production of yet another hormone Renal Pressor Substance. This RPS raises the blood pressure by causing arteriolar spasm. It can also cause gross arterial lesions and experimentally Selye has used it to produce lesions resembling intimal atheroma, Buerger's disease and periarteritis nodosa.[9] The site and type of the lesion in each case is presumed to depend upon locally conditioning factors. Again we see an example of the previously quoted law, that a beneficial factor may be exaggerated to become an offensive factor.[7] While DOCA is the chief offender in this respect, no stage of the G.A.S. is exempt from the risk of this grim law. Even the highly prized Cortisone can, in excess, cause diabetes, failure of healing, infection, Cushing's syndrome and acne.

(c) With continuous application of the stressor, the last stage eventually appears. This is the stage of exhaustion. There is now complete loss of all types of adaptation. This stage resembles the initial stage of Alarm (Mobilization). There is a fall in all normal levels and this heralds the onset of death.

As stated immediately above, when there is a continuous large-scale demand for adaptation, the power to adapt is eventually exhausted and the patient dies. This led Selye to postulate that every individual is born with a fixed amount

of 'Adaptation Energy'[6] and that when this supply is exhausted the individual has totally lost his power to adapt.

We need not accept this view, because there are at least two ways of becoming bankrupt. It is true that a man with a fixed capital will become bankrupt when he has spent it all. It is also possible for a man with an income to become bankrupt, if his expenditure exceeds his income and it continues to do so until his capital is also exhausted.

I propose the conception of a constant production or income of Adaptation Energy which may be stored (up to a limit), as a capital reserve of adaptation. Later I shall show that this conception best explains the clinical and Selye's own laboratory findings. It is possible that, had Selye's experimental animals been asked to spend adaptation at a lesser rate (below their energy income), they might have coped successfully with their stressor indefinitely.

However, Selye believes that every individual is born with a fixed quantity of 'Adaptation Energy'. According to this theory he can use up this capital entirely in adapting to one stimulus only, whether specific or non-specific; or he can spend it by using smaller amounts of adaptation on each of a great number of different stimuli; but when he has spent all his adaptation in one way or another, he dies.

Before proceeding further, the immense implications of Selye's theory must be realized. He is suggesting that all human experience and hardship weakens an individual in his power to cope with different stressors and that ultimately he can no longer cope with the original stressor. Other scientists have held the view that previous hardship causes a rise in the individual's general power of adaptation. Even common human experience seems to speak with two voices on this matter: since the time of Sparta it has been believed that a man may be toughened by previous hardship, so that eventually he can resist almost any strain. It is also believed that a man may be weakened by previous hardships, so that he falls an easy victim to subsequent strain.

FURTHER EVIDENCE SUGGESTING THAT PREVIOUS STRAIN WEAKENS AN INDIVIDUAL

Selye subjected batches of rats[6] over a period of about 10 days to various sorts of severe alarm stressors such as cold, extreme exercise and different poisons. Each batch received only one sort of stressor at first. When such a batch was subjected to a second and different stressor they took it very badly and had a much higher death rate than when subjected to their first stressor. No such mortality occurred if the second stimulus was the same as the first, i.e. they had learned and now possessed, a store of specific adaptation energy. This suggests that death was due to a bankruptcy in non-specific adaptation energy. This view is confirmed by the fact that death occurred very quickly, i.e. in the stage when non-specific adaptation normally comes into play.

These results are surprising. We believe that adaptation to drugs such as morphine and alcohol can occur, but it is adaptation at a price; the individual can tolerate more of his drug, but with this tolerance his general health is enfeebled. Clinically we have learned to expect that such a drug taker adapts badly to the strain of operation or disease. However, it is a surprise to learn that the 'physiological' stressors (such as cold and exercise) also result in a lowered tolerance towards any different second stressor. Previous adaptation to exercise resulted in a lowered tolerance towards cold and *vice versa.*

We may not accept Selye's grim view that a creature is born with only a fixed quantity of adaptation energy. However, very great credit is due to him for his experimental work. He has been the first to prove an incredibly simplifying law: Adaptation Energy is like money; it may be spent in one large project or it may be used up in a multitude of *different* petty expenditures.

Apart from laboratory work there is also a good deal of clinical evidence to support the view that previous adaptation to one stressor may cause decreased resistance to a subsequent different stressor:

(a) Pneumonia frequently 'supervenes' after a fracture, particularly a fracture of the femoral neck in old people. I have seen fatal pneumonia rapidly follow upon simple, bilateral tibio-fibular fractures in an old man. Selye has produced such pneumonias experimentally and considers that their development is favoured by the oedema of the lung (local conditioning factor) which follows on the universal increase of capillary permeability characteristic of the Alarm Reaction.

Pneumonia may also follow great exposure to the stressor of severe cold. Here, in Selye's theory, we find at last an explanation of the age-old conception that a 'chill' is dangerous. Intense cold, acting as a stressor to initiate the G.A.S. experimentally, can routinely cause gastro-intestinal ulceration as a part of the Alarm stage. In conjunction with Corbett, I reported a clinical case where death occurred from gastro-intestinal erosion after intense cold[10]; at the time (1940) we were unaware of Selye's theory.

(b) In malarial areas trauma will often 'light up' an otherwise latent malaria. An apparently healthy young soldier was admitted to an equatorial military hospital (itself situated in a non-malarious spot). I operated on him for hernia. Post-operatively he developed high fever and blood examination showed malignant tertian parasites; it seemed very probable that the malarial parasites had been present before operation, although he had never had any clinical symptoms of malaria; he had been able to adapt himself completely to the presence of the parasites until the preliminary stressor of the operation had exhausted this adaptation to malaria.

(c) A patient had been in hospital several weeks (presumably far beyond the incubation period of typhoid fever) when I finally operated on him. Post-operatively his temperature rose steadily in step-ladder fashion. As no other cause could be found for his pyrexia, a Widal test was eventually done. This was of diagnostic titre and there seemed little doubt that he was now suffering from typhoid fever. There were no other cases in hospital or indeed in the district. The strictest enquiry could reveal no possible source of infection, not even from gifts of food. The conclusion seemed inescapable that he was a latent typhoid carrier and that resistance to his own bacilli had been lowered by the stressor effect of the operation.

(d) A remarkable association between severe exercise and liability to poliomyelitis has been demonstrated, both clinically and experimentally.[11] It cannot be doubted that those who are exposed to the infection are more likely to take it and to take it severely, if they have just undergone severe exercise. There has been much recent evidence to suggest that injection of pertussis vaccine may induce liability to poliomyelitis. The relation to Selye's theory is obvious: The first vaccination has acted as a stressor so that there is diminished adaptation energy available for coping with the infection of poliomyelitis.

(e) Examples such as these could be multiplied. In all such cases expenditure of one type of 'Adaptation Energy' has resulted in a scarcity of a different type of 'Adaptation Energy'. Presumably many different specific systems of adaptation and also Non-Specific or General Adaptation all share some essential common component. Thus expenditure of Non-Specific Adaptation may result in scarcity of previously acquired specific adaptation.

A striking difference should be noted between the above clinical observations and Selye's experimental observations on rats. In the clinical cases disease followed quickly on the heels of the initial physical stressor; in the experimental cases there was an interval of about 10 days between the initial stressor and the final fatal stressor. This period is roughly 1/60 of a rat's life cycle. In terms of a man's life this is about one year. There is absolutely no shred of clinical evidence to suggest that about a year or more

after a severe alarm reaction, a man has less power of adaptation to other stressors (such as accident, operation or disease). If anything the contrary appears to be true.

EVIDENCE SUGGESTING THAT PREVIOUS ADAPTATION STRENGTHENS THE INDIVIDUAL TO RESIST FUTURE STRESSORS

(a) Alexis Carrel[12] has been the foremost proponent of this view. He points out that when an individual fails to react to certain stimuli, he may react to them after he has been forced to react to a totally new stimulus. Thus men moved to mountain air, where they must forcibly adapt to a lower oxygen tension, immediately become more vivacious and reactive to stimuli generally. The abrupt stimulus of a cold shower produces a similar effect. In other words, the necessity for adaptation to one stimulus has awakened and increased the power of reacting to many other stimuli. (This view is a logical converse of Pavlov's theory which regards sleep as a spread of inhibition over the whole cortex, as a result of the functioning of a single inhibitory reflex.)

Carrel's views are a matter of everyday observation but, before him, no one had expressed the matter in clear language. It is surprising that such a master of the experimental method as Carrel should have been content to leave this valuable theory without experimental support; it should be tested under controlled laboratory conditions. It would be especially interesting to be able to prove that the increase in adaptability ranged throughout the nervous biochemical and immunological systems, so that the necessity for adaptation in any one of these systems awakens all the others. It should be noted that Carrel's theory relates only to minor stimuli; unlike Selye's, his were less severe than Alarm stimuli.

(b) For centuries physicians have been aware that a change of air or resort to a bathing establishment had curative value in chronic disease. It is possible that the physician, in ordering a change of air, may have wished to rid himself of the embarrassment of a patient whose disease he could not cure. But whatever the motive, there is no doubt that such treatment is often effective. Nor can such success be explained away by the assumption that the new environment is less favourable to the *modus vivendi* of the causative bacteria; for no greater contrast can be imagined than between the climates of Switzerland and the Cape Province coast. Yet vast numbers of English consumptives have been cured by either climate.

Incidentally the Cape Province does not seem to be unfavourable to the development of tuberculosis for those actually born in the province. If Carrel's theory is correct we ought to send South African consumptives to England for the cure!

I saw a remarkable instance which proved the beneficial effect of climatic change on the course of tuberculosis. In 1940 I was on a ship which passed through the Panama Canal on its way to England. At the Canal Hospital I was called into consultation over the case of a British steward. Several months before he had been left behind by his ship because he was suffering from such severe pulmonary tuberculosis that he was too ill to proceed. Since then his condition steadily deteriorated until now he was a mere skeleton with a swinging temperature, a large cavity in his left apex and sputum crowded with tubercle bacilli. He was determined to travel back with us to England. In vain I pointed out the disadvantages and dangers of travel under war-time conditions to a man in his state of health.

Finally, I was forced to say that the change to the cold English winter might prove a grave danger to his life. 'Doctor,' he said, 'if I am to die, I would like to finish among my own people!' After that it was impossible to refuse him. He came with us on our long journey and the ship went steadily northward, making a wide detour to avoid enemy submarines. The climate grew rapidly more icy, but even when we approached the Arctic circle he appeared to be holding his own well, in fact I was forced to admit to myself that he seemed to be improving rapidly. Somewhere between Iceland and the Hebrides the ship was torpedoed and the survivors drifted in open boats over a near-Arctic midwinter sea. A few days later in a Northern Scottish hospital I was surprised to see this man alive. Not only was he alive but his ruddy complexion, firm flesh and brisk movements signified a fine degree of health. He was now symptom-free and, in the radiograph, evidence of his former large cavity was detectable only with difficulty. The sputum was negative. It was hard to believe that this was the half-dying man I had first seen only a month ago; the conclusion seemed inescapable that his remarkable transformation had been due to the change to an 'adverse' climate.

In Selye's experiments on rats a previous history of fairly remote exposure to a severe Alarm stimulus appeared to render them less fit to face future different stressors. Is this true of human beings? We must be careful to differentiate this problem from those in the preceeding paragraph where the reaction to mild stimuli was discussed. Practitioners have had much experience of soldiers exposed to great extremes of temperature, exhausting physical fatigue and periods of prolonged starvation; we know the reactions of Natives, whose lives have been a succession of such incidents; we have observed numbers of men addicted to strenuous and exhausting sports. It has already been conceded that all such men, as an immediate result of their severe preliminary stressor, are more liable to death from disease and trauma. But when this transient phase of susceptibility has passed, what is their reaction to severe trauma, both accidental and surgical and how do they react to sudden grave infection? Have such men been toughened by all their past trials or have they (according to Selye's views) been weakened by previous expenditure of a fixed capital of Adaptation energy?

Often the modern city has sprung up rapidly from the bare veld and at the periphery of the great blocks of luxury flats there still linger men of all colours who have survived the hazards of life under conditions of bitter stress. Thus there remains a fleeting opportunity for the city practitioner to compare the two classes of humanity. Admittedly there are factors which blur the issue. Alcoholism and syphilis are much commoner among those who have led the hard life and this would enfeeble their reaction to stressors. On the other hand, such men have a cheerful contempt for stress, as high morale often goes with low morals; and morale has a powerful though ill-defined effect upon survival under stress. When all these factors have been assessed and discounted I can give my own view without hesitation, based upon 25 years of practice: those who have led the hard life withstand trauma and acute disease as well as, if not better than those whose lives have been soft. I can even call to mind some remarkable cases of resistance on the part of patients who had lived the hard life. South African Natives have the reputation of being practically 'shock proof' after severe trauma. From all this clinical experience it is clear to me that men can re-create their spent capital of Adaptation Energy if given time to do so; there is an 'Energy Income' which may be saved to provide fresh capital. It is probable that the rate of income decreases with advancing age. Thus this part of Selye's theory receives no support from clinical observations. However, Selye's facts are explicable on an amended theory which I shall propose later in this paper.

It is strange that from the French-Canadian laboratory of Selye should have emanated this theory that previous adaptation weakens an individual. More than a century

ago from the same part of the world, came an account of resistance unsurpassable in the human story:

Alexis St. Martin, the French-Canadian voyageur, his body hardened and toughened by a life of continuous struggle accidentally discharged his own shotgun into his chest and abdomen. Beaumont,[13] the American surgeon, has written the classical account of this man's prolonged sufferings and amazing resistance. The patient was eventually left with a permanent gastric fistula through which Beaumont studied his gastric mucosa. Both before and after his terrible injuries, St. Martin's life was one long round of exposure and hardship in bitter climatic conditions. Beaumont relates how he paddled his canoe, fully laden with his wife and children and all possessions, for thousands of miles even before his wounds were properly healed.

Lately, Sir Adolphe Abrahams[14] has given an interesting account of the autopsy on a man who died of malignant disease of the thyroid:

In his youth this man's feats as a long-distance cyclist had been legendary; he was probably the greatest long-distance cyclist of all time. At the age of 18 he had broken the record for the Land's End to John O'Groats trip (over 600 miles). He repeated this great feat of endurance no less than 24 times, although contemporary physicians warned him that each feat would cost him 10 years of his life. In spite of thus losing 240 years of his life he lived to the age of 78 years and autopsy disclosed a remarkably healthy heart and coronary vessels. All other viscera appeared healthy.

(To be concluded)

SPINAL ATROPHIC PARALYSIS

FOLLOWING LIGHTNING STROKE

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In South Africa where violent thunderstorms are frequent in summer, death due to lightning stroke is common. It is surprising that amongst those who survive, complete recovery is the rule and neurological complications are very rare. Amongst survivors the immediate results are shock, suspended animation and frequently kerauno-paralysis, i.e. a transient flaccid paraplegia with objective sensory loss, which may be accompanied by disorders of the extrapyramidal system and by changes in the electro-encephalogram (Patterson and Turner, 1944). Superficial burns, especially along the skin creases and beneath metallic objects in the clothing, invariably occur.

Several neurological disorders have been described following lightning stroke, but Panse (1930) (cited by Critchley, 1934) considers spinal atrophic paralysis, a condition closely resembling amyotrophic lateral sclerosis, to be the characteristic sequel.

CASE REPORT

Three months before admission to the hospital, a Mauritian carpenter aged 46 years was struck by lightning near some trees on his way home across the veld. He was quite certain no rain had fallen before he was struck. He was found unconscious in a ditch two hours later and was taken to the local hospital where he regained consciousness the next afternoon. He was found to be suffering from shock and extensive second degree burns of the trunk and lips. The front of his hat had been burned off and the rest of his clothing severely damaged.

His burns were slow in healing and it was six weeks before he was fit to be discharged. During that period no neurological abnormalities had been found.

Two weeks before admission here he developed a transient pain between the shoulder blades and an aching of the muscles of the hands. A week later he felt pins and needles in his finger tips spreading up to his elbows. Shortly afterwards he had spasms of the flexors of the fingers and later was unable to clench his fists. He then sought medical advice and was admitted to this hospital on 14 May 1950.

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Examination showed him to be a thin, intelligent man. The scars of his burns were very prominent. The lower lip was burned, the neck escaped and the burns started again at the upper end of the sternum and ran down to the abdomen, branching out to both groins. The thighs were not involved but there was a small burn just above the left ankle.

No further abnormalities could be found except in the central nervous system where the signs were much more pronounced on the left side of the body.

Head and Neck. While the tongue was not wasted there was a marked fibrillary tremor of it and the muscle of the lower lip.

Upper Limbs. Power and tone were diminished in both arms and he was unable to flex the fingers of his left hand fully. There was definite muscular wasting and fibrillation in the small muscles of both hands. Fibrillation was also seen in all the muscles of the left arm and in the left pectoralis major. This was intensified by the injection of Prostigmine.

All the reflexes were exaggerated and both Wartenberg's sign and Hoffman's reflex were easily elicited.

Lower Limbs. Power was reduced in both legs and he could walk only with difficulty. Tone was increased but there was no apparent muscular wasting or fibrillation.

The knee jerks were exaggerated, but neither the ankle jerks nor the planter reflexes could be obtained. Perception of pin prick was diminished over both feet as high as the ankles. No other abnormality of sensation was found.

INVESTIGATIONS

Blood: Haemoglobin: 12.95 gm. %.
White blood cells: 4,800 per c.mm.
Cerebrospinal Fluid:—Protein: 50 mg. per 100 c.c.
Globulin: Moderate excess.
Cells: 6 lymphocytes per c.mm.
Chlorides: 730 mg. per 100 c.c.
Lange curve: 1344443311.
Wassermann Reaction: Negative in blood and cerebrospinal fluid.
Urinary Lead Excretion: 0.020 mg. for 24 hours.
Chest X-ray: Normal.

Treatment and Progress. It was decided to try the effects of vitamin E on this patient and 500 mg. of alpha-

Ten slotte wil ons graag daarop wys dat praktisyns nie gebind is deur die *Tarief* wanneer hulle lede van 'n niegoedgekeurde Mediese Hulpvereniging behandel nie (d.w.s. dié van wie die name nie in die lys in die tarieweboek verskyn nie); hulle behoort hulle die gewone gebruiklike gelde vir private pasiënte te vra. Dit sal as oneties beskou word om op enige ander basis aan sulke pasiënte dienste te verskaf. Hierdie saak was in die *Tydskrif* van 15 Desember 1951 bespreek, bladsy 940.

Finally, we would like to point out that practitioners are not bound to the *Tariff* when attending members of unapproved Medical Aid Societies (i.e. those whose names do not appear in the list in the *Tariff* book); they should charge them ordinary customary fees for private patients. It would be regarded as unethical to render services to such patients on any other basis. This matter was discussed in the *Journal* of 15 December 1951, page 940.

DIE DOEL VAN ONS TYDSKRIF

Sedert die *Tydskrif* 'n weekblad geword het, was dit moontlik om medies-politieke nuus op baie korter tussenposes vry te laat. Daar was ook 'n baie bevredigende toename in die aantal en gehalte van oorspronklike artikels wat vir oorweging voorgelê is.

Ons moet egter nie die feit uit die oog verloor nie dat ons plattelandse kollegas in algemene praktyk in 'n baie goeie posisie is om uit die rykdom van hul kliniese ondervinding bydraes aan hulle stedelike mede-praktisyns mee te deel. Graag wil ons hierdie geleentheid te baat neem om hulle aan te spoor om, meer dikwels as wat in die verlede die geval was, kliniese bydraes aan die *Tydskrif* voor te lê.

Hoewel dit die eeu van kern-splitsing en van gemeganiseerde laboratorium-ondersoek is, word die belangrikheid van kliniese ondersoek nie veronagsaam nie. Die plattelandse geneesheer het 'n belangrike bydrae om te lewer tot die ontwikkeling van kliniese navorsing en vordering. Die *Tydskrif* verwelkom sy pogings op hierdie gebied.

THE SCOPE OF OUR JOURNAL

Since the *Journal* has become a weekly publication, it has been possible to release medico-political news at much more frequent intervals. There has also been a very satisfactory increase in the number and the quality of original articles submitted for consideration.

We must not, however, lose sight of the fact that our country colleagues in general practice are in a very good position to contribute from their wealth of clinical experience to their city cousins. We would like to take this opportunity of urging them to submit clinical contributions to the *Journal* more often than they have done in the past.

Although this is the age of nuclear fission and of mechanized laboratory investigation, the importance of clinical investigation has not been dissipated. The country practitioner has an important contribution to make to the development of clinical research and progress. The *Journal* would welcome his efforts in these fields.

THE GENERAL PRACTITIONER AND THE GENERAL ADAPTATION SYNDROME

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(*Concluded from p. 92*)

ATTEMPTS TO INDUCE PATIENTS TO PRODUCE THEIR OWN CORTISONE

Rheumatoid arthritis is the classical example of a disease of adaptation. Selye believes that, during the process of adaptation, the adrenals of these patients produce an unbalanced excess of mineralo-corticoid which, because of some locally conditioning factor around joints, causes peri-articular fibrosis. Cortisone physiologically neutralizes mineralo-corticoids and Hench's[15] use of Cortisone in the alleviation of this disease is now classical. However, we may well ask why the adrenal should produce an abnormally high ratio of mineralo-corticoid.

Selye has emphasized that the mechanism of the G.A.S. consists of a chain of events, each of which sets its successor in motion. This chain can be modified or 'conditioned' at any level either by special factors already present within the patient's body (internal conditioning) or by some factor peculiar to the Alarm stimulus itself (external conditioning). Selye has produced internal conditioning experimentally. By an excessive protein diet he has conditioned the syndrome at the pituitary level so that an excess of mineralo-corticoid was produced[8]; at the renal level an excessive amount of salt modified the syndrome so that the kidney produced an excessive quantity of renal pressor substance (RPS).

External conditioning is much more difficult to produce experimentally with any certainty. It has been produced at the lowest level, i.e. at the level of the final target organ as in the oft-mentioned topical irritation-arthritis experiments; here, the formalin injected around the joint causes a G.A.S.; but the proximity of the irritant to the joint conditions the peri-articular tissue to the resultant increase of mineralo-corticoid, so that peri-articular collagen is laid down. No clear proof has yet been given that the G.A.S. can be conditioned externally at a higher level though it remains as a strong probability. Rheuma-

toid arthritis is believed to be due to excess production of mineralo-corticoid in the course of a G.A.S.

We may well ask at what level the syndrome is being conditioned to produce this excess and whether this conditioning is internal or external. It might seem that internal conditioning factors have affected some link in the G.A.S. of the rheumatoid arthritic, causing an unbalanced production of DOCA. Thus, even when a different Alarm stimulus was used, the adrenal would continue to be dominated by this influence and would merely pour out more mineralo-corticoid. Actually the work of Coste [16] appears to support this pessimistic view. He attempted, with many differing Alarm stimuli, to induce the adrenals of rheumatoid arthritics to produce excess of Cortisone. He was quite unsuccessful.

However, it must not be forgotten that shock therapy (including jaundice and injection of non-specific proteins) has often had a beneficial effect on rheumatoid arthritis. This suggests that some types of Alarm stimulus, while producing the G.A.S. could simultaneously condition the pituitary-adrenal axis (possibly at the adrenal level) to produce a higher ratio of Cortisone. If such a stimulus could be discovered and it proved to be convenient in its application, it would be of immense service; patients could then produce their own supplies of an otherwise scarce and costly hormone.

I decided to try insulin for this purpose for the following reasons:

1. It is a very convenient method of producing an Alarm Reaction.

2. An excessive dose is easily rectified with administration of glucose.

3. Cortisone is a gluco-corticoid, i.e. it produces glucose from proteins. When excess of glucose is present it is possible that this will be a signal to the adrenal cortex to produce less Cortisone, thus reducing the excess automatically. Conversely, a diminished blood glucose (such as insulin would cause) might signal the adrenal to produce more Cortisone. If these speculations were correct, a shock dose of insulin would be the ideal stimulus for the production of Cortisone, since the adrenal cortex would be receiving simultaneously a double stimulus to its production.

I tried this on a person who was suffering from the most severe rheumatoid arthritis. During the eight months of preliminary observation her disease had become steadily worse and had resisted all my therapeutic efforts. This eliminated the possibility that placebo treatment could have any value. The long preliminary observation period with no remission made it appear extremely improbable that the improvement was due to a remission rather than to the treatment.

Immediately before insulin the sedimentation rate was 104 mm. in one hour. Insulin dosage was gradually increased over a week until 50 units were given daily. At this dosage there was sweating, trembling and mild confusion. Treatment was stopped and within two days there was remarkable clinical improvement. Previously her hands had been fixed, but now she began to knit socks and to move about generally. Fall of sedimentation rate is characteristic of increased Cortisone DOCA ratio.

This is a single case and the dramatic improvement is, of course, no scientific proof that insulin shock will effect cure in any other such cases. However, this result is striking enough to commend it to the notice of those who have large groups of such patients available. These physicians should try out the method, using all available refined methods of assessment including biochemical and pathological investigation.

SUMMARY OF THEORIES

1. *Selye's General Adaptation Syndrome.* This is a ready-made mechanism to enable the individual to cope with all strange new severe stimuli; when the body learns how to cope with a specific stimulus, the G.A.S. is no longer essential to survival. The G.A.S. bridges the gap until specific adaptation has been acquired. The G.A.S. is an abstraction; it is never seen in its pure form because it may be altered (conditioned) at any level in the long chain of its causal mechanism either by external conditioning (the particular nature of the stimulus) or by internal conditioning (biochemical values peculiar to the individual).

Sequence of stages in the G.A.S.:—

(a) *The Alarm Stage.* This is characterized by a fall in the value of most biochemical and clinical constants and increased permeability of capillaries with transudation of plasma. I regard this as the stage of mobilization; if exaggerated, the individual may die in this stage.

(b) *Stage of Counter-Shock.* This is probably mediated by Cortisone. All fallen values begin to rise and the patient's general condition improves. Exaggerated output of Cortisone produces acne, diabetes, Cushing's disease, failure of wound healing, liability to infection.

(c) Counter-shock merges imperceptibly into the *Stage of Resistance.* This is mediated chiefly by mineralocorticoids such as DOCA. DOCA causes fibrosis and (acting via the kidney which it stimulates to produce renal pressor hormone) causes, by means of RPS, raised blood pressure and a variety of arterial diseases.

Histologically these lesions are identical with intimal arteriosclerosis, periateritis nodosa and Buerger's disease. This reaction of the pituitary-adrenal axis is especially liable to occur when there is excess of salt (conditioning at renal level) and when an alarm reaction is simultaneously produced by extreme cold. It is not yet known how or at what level, cold produces its conditioning effect. There are numerous other effects of DOCA all of them of great defensive value but, if exaggerated, offensive to the organism.

(d) Each of the three stages of the G.A.S. is primarily defensive. Each is capable of exaggeration to the point of offence. When this offence dominates the disease picture the illness has become a disease of adaptation.

(e) Each causative factor of the three stages is mutually inhibitory for the other; thus, either DOCA or Cortisone will inhibit the shock stage and Cortisone will inhibit all the numerous manifestations of overdosage with DOCA. Conversely, DOCA will inhibit the effects of Cortisone overdosage.

(f) Consideration of the last two paragraphs will explain why Cortisone is effective in diseases of such widely varying aetiology.

(g) By the time that the G.A.S. is well advanced into

the stage of resistance, the individual is adapting to the particular stimulus with specific adaptation. If the same stimulus is continuously applied, specific adaptation eventually fails and there is reversion to the original Alarm Reaction; here, too, non-specific adaptation has become exhausted and death ensues.

On the basis of these and further observations, Selye concludes that each creature is born with a definite fixed amount of 'Adaptation Energy'; when this is used up, death occurs.

This theory is rejected as being incompatible with clinical findings. I have suggested an alternative theory which seems to explain the facts: Adaptation Energy can be created, though the income of this energy is slower in old age; it can also be stored as Adaptation Capital, though the storage capacity has a fixed limit. If an individual spends his Adaptation Energy faster than he creates it, he will have to draw on his capital reserve; when this is exhausted he dies.

2. *Carrel's Theory.* Apparently Carrel considered only stimuli below the intensity of Alarm stimuli. He believes that the necessity to adapt to any stimulus will awaken the organism's entire adaptive mechanism (nervous, endocrinological and imunological) so that any of these systems will then react more promptly than they would have done otherwise. This interesting theory seems to be correct in the light of ordinary experience; it should be tested by experimental methods.

3. I have attempted to synthesize harmoniously Selye's laboratory theories, Carrel's shrewd speculations and my own experience in general practice into the following composite theory of adaptation:

A continuous minor stimulus is easily countered with continuous adaptation. Moreover, the *initial* effect of the stimulus is to awaken the entire mechanism of adaptation to a state of more rapid and efficient response. A stronger stimulus may demand expenditure of adaptation energy at a greater rate than it is produced; then the adaptation reserve will be drawn upon until it is used up and death occurs. Even before this stage of complete adaptation bankruptcy, the rate of output of adaptation is already maximal and any further demand by a different Alarm stimulus cannot be coped with. Thus the history of a recent severe need for adaptation will have weakened the individual in his struggle to adapt to a fresh severe stimulus and Carrel's phenomenon is completely overshadowed.

An analogy from everyday life may help to clarify this composite theory:

An energtic client walks briskly into a sleepy bank and presents a small cheque to be cashed. The cashier reacts briskly to this stimulating encounter and the sound of their transaction wakes up the other cashiers who had been half asleep and had not bothered to attend to their work. In this way several timid old ladies who had been waiting patiently are at once dealt with and the whole bank has become more alert to adapt to a variety of clients (Carrel phenomenon).

Later the same man rushes in and presents a cheque for an enormous sum, larger than the bank's daily income. Reserves will have to be drawn upon and this causes a state of alarm, but the bank manages to adapt itself to this strained situation.

Unfortunately this customer has been the prelude to many similar clients demanding large sums; there is a 'run on the bank'. It is true that customers wish to be paid in different currencies but this is of no help, since all currencies are changeable into sterling. For each succeeding customer the manager must try to make some fresh reserve available and he adapts himself decreasingly well to a sucession of difficult situations. In vain he begs his clients to come back next month. Eventually funds are exhausted and the bank is broken. It failed for the sum of two reasons:—

(a) The demand for a certain period exceeded the income over that period; (b) This demand continued for a longer time than the reserves could hold out.

IMPORTANCE OF ADAPTATION THEORIES TO THE WORK OF THE GENERAL PRACTITIONER

1. Cases of chronic disease and slow convalescence should be recommended to have a complete change of environment (to benefit by Carrel's law). To effect continuity of treatment, it is desirable that practitioners well known to each other, but living in different climates, should 'exchange' such patients.

2. The physician should try to spare his patients the ordeal of a rapid succession of alarm stimuli (particularly in ageing people):—

(a) In the presence of grave epidemics, athletic contests and gross physical strain should be discouraged. Those already suffering from grave infectious illness should avoid physical strain.

(b) Vaccination against one illness should not be carried out when there is an epidemic of a different disease.

(c) Multiple operations should be 'spaced', so as to allow the patient time to reaccumulate his capital reserve of Adaptation energy. The older the patient, the longer should be the time interval between each operation.

(d) In disease of adaptation the practitioner should try to find out which phase of the G.A.S. has become exaggerated from a defensive to an offensive state. This exaggeration may often be neutralized by a chemical induction of a different phase, e.g. the stage of mobilization may be exaggerated into the state of shock. But this may be neutralized by inducing the stage of 'fibrosis' by means of DOCA.

Similarly the Adaptation diseases of DOCA intoxication, should be treated by inducing the Cortisone phase. There is evidence that the following may be diseases of DOCA intoxication:—

Asthma, allergies, eczema, herpes zoster, Hodgkin's disease, iritis, leukaemia, lupus erythematosus, nephrosis, periarteritis nodosa, psoriasis, rheumatic fever, rheumatoid arthritis, spondylitis and ulcerative colitis. All these should be treated with Cortisone.

But if this hormone is not available the physician should induce the patient to produce his own hormone by some form of shock treatment calculated to 'condition' the adrenal cortex to produce a preponderance of gluco-corticoid. Such an attempt (using insulin) with an apparently successful result is described earlier in this paper.

Exaggeration of the Cortisone phase is probably responsible for acne, Cushing's syndrome, diabetes and failure of wound healing. In some of these diseases which failed to respond to any other measures it might be advisable cautiously to try the effect of DOCA therapy.

In paragraph (a) above I have stressed that patients suffering from severe illness should not be exposed to gross strain. Yet in this section I have recommended that certain diseases should be treated with severe shock treatment. These two recommendations may seem to contradict each other. However, it should be noted that shock

treatment is recommended only for diseases of adaptation; even then, the immediate result of the shock may be to absorb the last of the individual's capital reserve of adaptation energy so that he dies. Cases for shock treatment should be chosen with an eye on this risk.

SUMMARY

An attempt has been made to decide how one stimulus will affect an individual's power to respond to a different stimulus. The problem is of special interest to physicians since they will wish to know how patients struggling with a disease will react to an additional stimulus. Much evidence has been sifted and it seems that there are several different and apparently contradictory answers; yet, in different circumstances each of these answers is probably true:

1. If an individual is failing to adapt to a disease he may succeed in so doing, if he is exposed to a totally different mild stimulus (such as slight fall of oxygen tension).

2. In the process of adapting to this new stimulus he may acquire the power of reacting more intensely to all stimuli.

3. As a result of a severe stimulus an individual may not be able to adapt successfully to a second severe stimulus (such as a disease).

4. If he is already adapting successfully to a disease this adaptation may fail when he is exposed to a second severe stimulus.

5. In some diseases (those of Adaptation) exposure to a fresh severe stimulus may cure the disease. Here, too, exposure to an additional stressor will bring him nearer to death but the risk may be justifiable if it is likely to re-mould the adaptive mechanism to a normal form. An apparent cure of a chronic disease, by the use of insulin shock treatment is described. Practitioners are urged to try such simple shock therapy themselves, on Adaptation Diseases which are listed.

Of all the above different types of reaction (1) and (2) are the result of mild stimuli; (5) is the reaction of Adaptation Disease; the remainder of these apparently paradoxical results may be explained on the same simple lines as the individual's own financial balance sheet. Whether he spends his money in one way or another, he is subject to the same simple inexorable laws which relate income, expenditure and capital reserve with final bankruptcy. So it is with the currency of adaptation energy, where excess of expenditure over income will drain away capital, until all power of adaptation is finally lost. This is the moment of death.

ADDENDUM

Since the above was written I have read an article by Kersley *et al.*[17] describing their beneficial results with a large series of rheumatoid arthritis cases treated by insulin shock therapy. They adopted this treatment purely as an empirical measure, whereas I was led to it by inductive reasoning. They give evidence to show that insulin shock probably causes the liberation of Cortisone-like substances.

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FULL-TERM EXTRA-UTERINE PREGNANCY

A CASE REPORT AND A REVIEW

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This case is reported because of its interest and comparative rarity. Textbook literature on advanced abdominal, or preferably, extra-uterine pregnancy is so scanty that the subject has never been described fully as a clinical entity.

Several cases have in the past few years been reported in this country, *vide infra,* all in Bantu women, and in the light of this and other literature, several comparisons regarding clinical signs, diagnosis and treatment have thus been possible.

CASE REPORT

Previous History. The patient was a Native female (Winnie), 23 years old and fairly intelligent. At the age of 15 she gave birth to live twins, one of whom has since died. There have been no pregnancies in the interim; but she has a positive Wassermann reaction. She has refused regular treatment. About 5 to 6 years ago she began to lose weight rapidly, became chronically anaemic and developed the tell-tale cough. During this time her health has waxed and waned. She has been in and out of hospital