by a soft basi-hyal tract. The upper part of the hyoid arch (pharyngo-hyal), two or three weeks after the development of the cerato-hyal, is formed as a small stapedial plate. Afterwards, in most species, the second pharyngo-hyal is formed; and this may break up into three segments, and so give rise to an auditory chain of four pieces, viz., stapes, interstapedial, medio-stapedial, and extra-stapedial. Behind the distinct basi-hyal, there is a large first basi-branchial, with a rudiment of a second; and, embracing these, two broad hypobranchials, whose inner edges meet. From the upper surface of these arise on each side four small rudiments of cerato-branchials; but the support of the three branchial pouches, with their copious tufted gills, is a framework of four pieces of large extrabranchials continuous with each other above and below, the second and third pairs being broad bands, and the first and fourth large pouches; these send inwards short processes, so that the arches become pectinate. These four cartilages correspond with the four bars which protect the first three branchial pouches in the lamprey.

Most Urodeles possess four branchial arches, some forms only having three. In any case, only the first three carry gills, which are epiblastic in origin, and each of which is single and feathery. The hyomandibular cleft does not open; and the pier of the mandible is very complex, being attached to the skull by three processes behind, and sending forwards a pterygoid process, which is continuous with the one or two separate cartilages in the ethmoidal region. There is a large cerato-hyal bar, and the distal part may be broken up into three or even more pieces. In some of the larger forms of Urodeles, there is a separate epihyal, which coalesces with the suspensorium. In all, a small pharyngo-hyal rudiment fills the *secondary fenestra ovalis* as an opercular plate; and in some kinds, such as *Menopoma*, *Cryptobranchus*, *Spelerpes*, and *Desmognathus*, there is a second pharyngo-hyal nucleus of cartilage, which becomes partly ossified from the stapedial plate; thus we have an auditory columella, or incudo-stapedial rod. The subdivision of the branchial arches is much less than in fishes; only the two first are divided at all, and these have a very short cerato-branchial in comparison with the epibranchial. This latter segment loses no part above as a pharyngo-branchial. There are two basi-branchials. The part which supports the larynx—the so-called thyro-hyal—differs in these two types; that of the Urodeles resembling the bird, in that the dilated distal end of the second basi-branchial performs this office; whilst in the frog, as in the mammal, the larynx is supported by hypobranchial bars. The gill-arches become largely absorbed both in Urodeles and in Anura; but these will be referred to again when describing the Branchiata.

In the Selachians, we find the most perfect development of the visceral arches, all of which in an early state bear branchiae. The first of these forms both the upper and lower tooth-bearing cartilaginous jaws, whilst the hyoid differs but little from a normal branchial arch. The upper part of the first arch (pterygo-quadrate) is attached to the skull by ligaments, one in the ethmoidal, and the other in the post-orbital region. The pedicle in this part is deficient: it is represented by a separate metapterygoid cartilage in the skate, and by from one to three small rays in the shark. In most forms, the upper part of the hyoid arch (hyomandibular) carries both its own lower segment, and is also attached to the hinge of the jaw. Hence this kind of skull is called *hyostylic*.

In *Chimæra*, as in the *Dipnoi*, the hyoid does not assist in supporting the mandible, the pier of which is fixed to the base of the skull, and thus the skull is spoken of as *autostylic*. In a few Selachians, however (viz., *Cestracion*, *Notidanus*), there is a sort of transition between the two; hence called *amphistylic*. The hyomandibular of the shark corresponds to a pharyngo- and an epi-hyal, and is directly in a line with the lower piece; in the skate, it is merely a pharyngo-hyal, and is dislocated forwards from the rest of the arch. There is in both types a single basi-hyal.

The branchial arches are divided into the normal pharyngo-, epi-, cerato- and hypo-branchials, with a basi-branchial plate common to them below; this is nearly divided longitudinally into two parts in the skate, but in neither type is there any cross segmentation. In the hyoid of the shark, the branchial rays are pectinate, but those on the branchials are simple; each of these latter arches has an extrabranchial outside. In skates, the rays are all simple, and dilated at their ends, and there are no extrabranchials. There are seven arches behind the hyoid in *Heptanchus*, six in *Hexanchus*, and five in all other Elasmobranchs.

In the Sturgeon, the arches are more or less ossified, and rays still linger on them, but there are no extrabranchials; the pharyngo-branchials of the two first are double. The mandibular and hyoid arches are greatly modified; the pterygo-quadrate and Meckel's cartilage are not large, and are very free under the skull. Their upper part

is fastened behind to a large shield-shaped metapterygoid plate, composed of a tessellated series of paired and unpaired cartilages. The hyomandibular is immense, and a separate symplectic is detached from it; between this and the cerato-hyal there is a separate interhyal. There is no separate epihyal; this seems to be included in the hyomandibular. The middle of the hyomandibular and the cerato-hyal are greatly ossified. This is the most pronounced of all hyostylic skulls.

Lepidosteus approaches the Teleostei, but the separate metapterygoid bone is articulated with the skull, and the hinge of the mandible is far forwards; there are also mesopterygoid and palatine splints. The palato-ptyergoid cartilage is not ossified, and is free in front. The symplectic is separately ossified, but not cut off as in *Acipenser*. There are five proper branchials in both *Lepidosteus* and *Acipenser*, but the hinder ones are imperfect. The skull of *Lepidosteus* is amphistylic.

In Teleostei, the skull is hyostylic. The palatines are ossified and articulated with the skull, and there is a quadrate and a metapterygoid, besides the pterygoid and mesopterygoid splints. The symplectic is a separate ossification of the large hyoid pier; both the interhyal and epihyal are ossified, the latter as a separate centre of the cerato-hyal piece. The hypohyal, as in *Lepidosteus*, is segmented off; in the latter, it has one bony centre, while in Teleostei there are two. In both types, the glosso-hyal (or basi-hyal) is generally bony and dentigerous. The five branchial arches are more or less ossified, are normally segmented, and have no cartilaginous rays, but small bones and tooth-rasps. They degenerate behind; and, in Teleostei, the pharyngo-branchials carry teeth to oppose those on the last rudimentary arch—a mere cerato-branchial, which is spoken of as the inferior pharyngeal bone, the upper dentigerous pieces being called the superior pharyngeal bones.

CARDIAC THERAPEUTICS.

By E. WOOD FORSTER, M.R.C.S.Eng., L.S.A., Darlington.

CASE 1.—In June 1880, I was called to attend a young gentleman about fifteen years of age. I found that he had suffered for some time from intermittent pains of the left mammary region; that he complained of being soon tired—soon pumped out; that his breathing, too, would be inconveniently rapid after running or undertaking an ascent. There was also a history of nervousness, of being easily startled, of considerable timidity, and of calling out in sleep. His family is subject to hereditary renal disease; and upwards of two years before this time there had been, to my knowledge, albuminuria without organic disease. Now, the urine was clear and non-albuminous.

The functions of the liver and stomach were healthy. Examination of the heart showed absence of valvular lesion, but slight hypertrophy with energetic impulse, and pulsations about 100 per minute: an intense condition of cardiac irritability. There was not an actual intermission of pulse-waves; but it was very noticeable that a succession of stronger beats was followed by a succession of feebler ones.

In connection with hygienic influences, digitalis was administered on the 18th, five drops three times a day in half an ounce of simple water, and continued until the 30th of June. To this time it had not "quieted the system"; but the neuralgic stitches of the mammary region were well, and the pulse-waves flowed more regularly. The cardiac irritability, with high pulse-beat and disagreeable nerve-consequences, still remained. On the 30th, three drops of *veratrum viride* were repeated three times a day in half an ounce of simple water. This treatment was most efficacious, so that in two or three days the medicine was ordered to be taken only once a day, or every other day, and was discontinued at the end of the fortnight.

I believe it would have been more therapeutically correct to begin at once with the *veratrum*. The general system of arterioles was healthy, and did not require to be interfered with. The indications were that the heart-muscle was the organ to which a remedy ought to be applied. It was not the regulating apparatus that was at fault, but rather the musculo-motor to which attention was to be directed. Digitalis therefore failed, because it is a musculo-motor stimulant. This was not required in such a case as I have just described.

Veratrum "diminishes the force of the heart-beat by a direct influence on the cardiac muscle" (Wood)—I presume through the musculo-motor ganglia. And the advantage of the small dose is that, firstly, we so use our remedy that its influence does not extend to other organs, but is expended on that organ which, being diseased, most sensitively feels its therapeutic power; and, secondly, we keep clear of inducing any disagreeable effect on the patient; and thus, by keeping well within the therapeutic dose, we can effect a "safe, speedy, and permanent cure, whenever a cure is possible".

CASE II.—On May 18th of last year, I was consulted by a lady of about seventy years. She came panting into my room, with livid lips, dilated nostrils, and a bumping heart. There was evidence of an obstruction of the liver, with some stomach-derangement, and scanty urine, containing urates, but non-albuminous. There had been for a month oedema of the right leg. There was mitral disease (said to be hereditary), rapid cardiac action, pulse 90, palpitation, intermission, and a short dry cough. Undoubtedly the heart was primarily at fault; but its condition was aggravated by the obstructed state of the hepatic system, the consequence of its own incompetency. By the third day, these obstacles were removed; the colour and odour of the evacuations became natural; and the urine increased in quantity under small doses of mercury.

Attention was now entirely given to the heart, and tincture of spigelia (Savory and Moore's) was administered. This is a powerful remedy in suitable cases; to this I can testify. (See Phillips; also Sharpe in *Practitioner*, May 1878, p. 331.) It was given because of its special action on the heart. The kidneys, acting well, did not require the subordinate action of digitalis. Likewise, the rapid irritable state of the cardiac muscle seemed to imply nervous excitement; therefore the exclusion of digitalis. However, spigelia failed to relieve, in five-drop doses thrice daily, the cardiac oppression and its concomitants. Why did it fail? Therapeutically, it was a wrong remedy. The small dose kept up the force and frequency of the heart's action. It probably acted as a stimulant to the accelerator nerves, and tended to increase the venous congestion. If I had given large doses, I might have considerably lowered the pulse; but then spigelia at the same time physiologically produces palpitation, with strong beating.

On the 25th, the cardiac agitation, dyspnoea, and hot dry skin pointed, with no uncertain indication, to aconite. One minim of Fleming's tincture was given in half an ounce of simple water thrice a day. Its efficiency was quickly apparent. In the course of a week, there was amelioration of all the symptoms; and, when I saw the old lady on July 4th, she was well and jocose.

"The method by which the aconite influences the heart is not certainly settled" (Wood). Therapeutically, in small doses, its beneficial influence is exercised through the cardiac ganglia. The hot dry skin was an important indication of treatment. Aconite, being known to dilate the arterioles, and to "increase the capacity of the vascular system" (Ringer), promotes perspiration and relieves congestion. Thus we obtain, in addition to the direct action on the cardiac ganglia, a powerful drain to the surface.

In weighing the probabilities between veratrum and aconite in a case of cardiac disease, we should deliberately consider the totality of symptoms present in the particular case. In the former case, veratrum was chosen, because of its direct effect on the heart *only*. The kidneys were acting normally; the skin also was normal; and temperature was normal; therefore, to have given aconite in such a case would have been a needless waste of aconite influence, and might possibly have produced a feeling of increased lassitude. In the latter case, veratrum would not have touched either the kidneys or the skin. As aconite embraced these within its beneficial range, it was emphatically *the* remedy, and did not require the clumsy expedient of combining with it spirits of nitre, or potash acetate, to effect that which it was quite capable of doing alone.

The advantage of the single medicine is its simplicity, and its accuracy in operating *only* upon the diseased organ in proper therapeutic dose, which must be far removed from the physiological one.

If a medicine have a special action upon a special organ or part in health, so it would seem very desirable and judicious to administer that particular remedy in disease of that same part which appropriates the remedy in health. But we must bear in mind, as a clinical fact, that the tissues in disease are much more sensitive and responsive to the action of a drug, so that the dose to be then therapeutic must be small.

ANDOVER.—Mr. Farr has little to report for the past year. He states that of the total deaths (144) 64 occurred amongst persons over 60 years, and children under five years of age—a result which is attributed to the unusually severe weather which prevailed in the early part of the year. Of the zymotic causes, scarlatina was the most fatal, causing seven deaths, typhoid fever being credited with three, diarrhoea with two, and measles with two. Diseases of the chest were fatal to 13 persons, and heart disease to eleven, phthisis causing two deaths only. Alluding to the prevalence of typhoid fever Mr. Farr states, an inspection of the surroundings of the 43 cases which happened showed that they were due, directly or indirectly, to imperfect drainage. In this connection it is satisfactory to note that the Town Council have before them a scheme for the construction of a complete system for the disposal of sewage, and in other ways seem alive to the importance of their duties.

A NEW PROCESS FOR THE ESTIMATION OF URIC ACID.

By EDMUND ALLEYNE COOK, F.C.S., L.R.C.P. & S.Ed., etc.

THE published methods for the estimation of uric acid are numerous; but, from the now classical mode of adding hydrochloric acid and crystallising, to the last of Pavy, they are either unpractical or otherwise unsatisfactory in their application to the estimation of the uric acid in urine; nevertheless, the number of efforts made in this direction are sufficient proof of the desirability of a good process.

The process of precipitation by hydrochloric acid is unsatisfactory, on account of the whole of the acid not being thrown down, even after prolonged standing, and the proportion left in the solution, if urine be the substance operated on, is very different from that which remains after the decomposition of a simple urate solution, and varies with the varying constituents and the gravity of the original liquid. In 1871, Salkowski proposed to precipitate the urine by hydrochloric acid, and then, after removing the precipitate, to render the solution ammoniacal and filter, and then precipitate by a solution of nitrate of silver; but this process never found favour: for, although to a certain extent more accurate, it was much more troublesome.

From a table of twenty-eight experiments, the following are extracted.

No. of Experiment.	Urine in c. c.	Specific Gravity.	Uric Acid in 200 cubic centimetres.			Uric Acid Absolute Amount.
			By HCl.	By Ag Nos.	Total.	
15	1040	1019	0.0275	.. 0.031	... 0.0585	0.304
16	880*	1018	0.087	.. 0.026	... 0.113	0.477
17	1230	1018	0.033	.. 0.070	... 0.103	0.633
19	1500	1014	0.0 (?)	.. 0.031	... 0.031	0.232
23	—	1018	0.037	.. 0.044	... 0.081	—
26	900*	1017	0.0085 (!)	.. 0.059	... 0.0675	—

This process was commented upon by various observers, and it will be seen that, if it is to be considered accurate, we must modify greatly our ideas of the quantity of uric acid passed by an adult, as the results given are manifestly low.

Later, Bunsen proposed a method by heating the uric acid containing fluid with baryta, in a closed tube, with certain precautions; but the process is not readily executed, and not accurate.

In 1875, Fokker proposed a new method, which he considered not free from error, but still, more accurate than those then existing. It consisted in rendering the urine alkaline, and adding sufficient ammonium chloride to precipitate the uric acid as acid urate of ammonia; this was collected, treated with acid, washed, dried, and weighed. This process is certainly more accurate and practical than any previous, but it still seemed unsatisfactory: for, only a short time back, we find a proposal to revert to the old hydrochloric acid process, with the modification of violent agitation.

Pavy lately proposed a method by which the reducing action of uric acid on an alkaline copper solution was taken advantage of; and he showed that, in normal urine, his process was accurate enough, provided no other substance capable of reducing copper solution was present. I have tried this process, among others, and think it still leaves much to be desired. The colour of the urine is very apt to mask the terminal point of the reaction; and, it appears to me, urine is too varying a fluid to hope to apply any volumetric method to any constituent which exists in it in so small a percentage as does uric acid.

In contemplating some physiological experiments, all these processes, and some others, were passed in review, and found unsuitable; and, therefore, efforts were made to devise a better mode.

The amount of uric acid daily excreted by a healthy adult is variously stated by different authors, and is generally thought to be below ten grains per day, while the amount of urine passed averages fifty ounces. Taking these figures as accurate, it will be seen that the uric acid solution voided is equal to 1 in 2400, which is certainly a very dilute solution. The urates are all slightly soluble in water, and a very insoluble compound would be necessary in order to precipitate a proportion of uric acid so small as exists in ordinary urine.

After many trials, it was found that urate of zinc was probably the most suitable insoluble compound to form a basis for a process to estimate the acid. If to a solution of urate of soda, slightly alkaline, a solution of zinc sulphate be added, a white gelatinous precipitate will be thrown down; and if 100 c. c. of a very dilute solution of zinc sul-

* Not all.