Dr. Allen: I would like to include W. H. Atkinson with Dr. Maynard.

Motion seconded and passed.

Dr. Noble: I wish to say that our old friend Dr. Maynard came to this city about thirty-five years ago. I came here as a young man and as a student, and I well remember at that time with what veneration we looked up to Dr. Maynard, who was then in the very height and pride of his national reputation. I wish to bear personal testimony to his wonderful skill with his fingers; his manipulative ability, not only in the matter of filling teeth, but his knack in the way of using tools and instruments in the laboratory. One of the most wonderful men I ever knew with reference to executing what his brain thought out; and we all know what a large brained man he was; and that for many years he was looked upon as one of the leaders in our profession in all things that pertain to advancement in the way of mechanical appliances. He was one of the first to thoroughly remove the nerve, and probably with more thoroughness than was done before or for some years afterwards. This was mainly due to the care which he took in preparing the fine nerve broaches which we are now familiar with. I also feel proud of having his name on my diploma along with that of Drs. Harris and Bond. I think there is only one man living that was on my diploma, and that is Professor Sterner. I feel deep sorrow to hear of the death of Dr. Maynard. Of latter years you have not heard very much of him, and I am sorry to see there has been some language used with reference to Dr. Maynard that seems to me uncalled for; that he has not taken an active part in societies, his age preventing. I hope we will always be ready to say, peace to the ashes of Dr. Maynard; for he certainly was deserving of veneration. As an operator he stood at the very top of our profession. He was always dignified, and as we all know bound up with our profession.

Dr. Talbot: Those in favor of the resolution offered by Dr. Williams, please manifest by saying aye. Seconded and passed unanimously.

Dr. Talbot: I will appoint on that committee Dr. Noble, Dr. Allen and Dr. Williams.

Dr. Marshall: Mr. Chairman, I have been over the paper of Dr. Thompson's and think I can get through it.

Dr. Talbot: The next paper then in order will be that written by Dr. A. H. Thompson of Topeka, Kas., on "The Teeth of Invertebrate Animals." It will be read by Dr. Marshall.

Dr. Marshall: This claims to be a type-written copy of the paper, but whoever did it did not know very much about typewriting. It is not well printed and it is on extremely thin paper, and I can only see it by holding it in a rather awkward way; so that if I stumble it will be because of poor printing.

(Dr. Marshall then read the paper.)

THE TEETH OF INVERTEBRATE ANIMALS.

BY ALTON H. THOMPSON, D.D.S.,
OF TOPEKA, KAN.

The resources of Nature are infinite. The expedients to which she resorts are marvelous and endless in their variety. When new conditions are to be met, her invention is never at a loss, and her capacity for change is boundless. Environments change and corresponding alterations in organs arise to meet the new conditions presented. The life of a species depends upon this power to change, to conform to new environments. The law is adaptation or extinction.

In no set of organs—in animal life at least—is this infinite variety of resources, or the capacity for change, or the power of invention, so fully illustrated, as in the teeth. Food selection has created a wonderful variety of forms of teeth which have arisen in response to changes in the food environment. Those species which could conform to gradual change, survived and transmitted the acquired modifications in the dental apparatus. Those which could not change, perished; or escaped to a more favorable food environment. From such causes many variations in the teeth of animals arose in the course of the geological ages, and, taking the living and the extinct species altogether, the number and extent of these variations is beyond estimation. The variety presented in the different forms of teeth and masticating apparatus throughout the animal kingdom, illustrates and exemplifies the fact that these organs are susceptible of great variation, and that the possibilities of change and the invention of Nature, are especially marked in these organs.

If vertebrate animals present great variations, and many extraordinary forms and interesting extremes in the structure of the dental armature, so also do the invertebrate animals, although these are not so well known. To the naturalist and the philosopher the latter are equally interesting, however, and serve to enlarge our views of the wonders and beauties of nature. To the dental student the teeth of invertebrates are interesting from the comparative standpoint, and serve to illustrate the remarkable possibilities of dental variation, and help to better understanding of the principles of the mechanical evolution of the teeth of animals. In such studies, any knowledge is valuable which may contribute, even remotely, to a better understanding of the important organs which we are called upon to preserve, and thus better prepare us for our chosen work. The study of comparative anatomy is of great value for the side lights it throws upon the teeth of man—their origin, evolution, mechanical design, etc.,—and therefore we claim that the

study of a branch, even as far removed from man as the invertebrates, is of sufficient value to warrant us in presenting a brief epitome of our knowledge of this branch; by way of stirring up an interest in it as an incentive to further study and investigation.

Professor Huxley says, "Anatomy of Vertebrates:" "When invertebrated animals are provided with teeth or masticating organs, the latter are either hard productions of the alimentary mucous membrane, or are modified limbs, as opposed to vertebrated animals, which also usually possess hard productions of the alimentary mucous membrane in the form of teeth; but their jaws are ordinarily parts of the walls of the parietes of the head, and have nothing to do with the limbs." The vertebrate jaw is part of the endoskeleton—the invertebrate jaw belongs to the exoskeleton, as do the teeth of all classes of animals, as illustrated by their embryology.

Mr. W. H. Dall says, "American System of Dentistry:" "Almost every large group of organisms below the vertebrates, until we reach the Moluscoidæ and lower radiated animals, exhibits in some of its members, one form or another of prehensile or masticatory apparatus connected with the alimentary canal. None of these exhibit true homologies with vertebrate teeth, though some of them present remarkable similarity to the latter in external relation. . . . They are divided into manibular and dental appendages in the sense in which the latter may be said to exist in the invertebrates. . . . Throughout the invertebrates the teeth are dermal structures, however much modified, and may consist of calcified connective tissue, of horny matter, or of chitin or an allied substance. . . . The teeth and jaws of mollusks, the nippers, mandibles and setæ of worms, are composed to a greater or less extent of chitinous material."

Prof. A. S. Packard says, "Standard Natural History:" "Hard bodies serving as teeth occur for the first time in the animal series, in the sea-urchins, where a definite series of calcareous dental processes or teeth, with solid supports and a complicated muscular apparatus, serves for the comminution of food. . . . Among the worms the organs of mastication for the first time appears in the Botatoria, where the food, such as infusoria, etc., is crushed, and is partly comminuted by the well marked horny and chitinous pieces attached to the mastax. In most other low worms the mouth is unarmed. In the leech there are three, usually in the annelids, two denticulated or serrate, chitinous flattened bodies situated in the extensible pharynx of these worms, and suited for seizing and cutting or crushing their prey.

"In the higher molluscs, such as the snails and others, besides one or more broad pharyngeal jaws, comparable with those in the worms—is

the lingual ribbon, admirably adapted for sawing or slicing sea-weeds, or cutting or boring into hard shells, acting somewhat like a lapidary's wheel; this organ, however, is limited in its action, and in the cuttles, the jaws, which are like a parrot's beak, do the work of tearing and biting the animals serving for food.

"In the crustaceans and insects we have an approach to true jaws, but here they work laterally, not vertically, as in the vertebrates; the mandibles of the articulate are modified feet, and the teeth on their edges are simply irregularities or sharp processes, adapting the mandibles for tearing and comminuting food. The numerous teeth lining the crop of crustaceans and insects, serve to further comminute the food, keeping the larger particles back till finely crushed."

Professor Bradley says, "Manual of Compar. Anat.:" "The lowest forms possess no teeth, except some ciliate infusoria, which have an internal cylinder of parallel rods for the mastication of food. . . . In the Rotifera the denticles are in the shape of denticulated plates. The Echinodermata have five large teeth placed in the formidable apparatus called 'Aristotle's Lantern.' In the Annulosa the leech is the only member that possesses teeth, the semi-lunar plates imbedded in the muscular walls of the mouth; but the remaining classes have only mandibles and maxillæ which are very hard and chitinous. Among the Molusca, the Gasteropods possess a strap-like organ, the odontophore, which is studded with teeth. Cephalopods possess horny jaws which move vertically. Some other classes have denticles besides."

"In the Annelids (Dall, op. cit.) so-called teeth occur in many groups, but partake rather of the nature of jaws than teeth. This group comprises most of the worms, as well as the leeches. Their bodies are divided into more or less well defined, regular segments, and in general the jaws are on the second or buccal segment, or on a proboscis which is itself on the outer edge of this segment, and may be protruded from the mouth to a considerable distance. They are chitinous, most commonly paired, lateral and opposite, of almost infinite variety of forms, resembling in a general way the maxillæ of insects, and mimicing in miniature, hooks, combs, saws, rasps, claws, etc.

"In the leeches the mouth is provided with three lenticular jaws, with the projecting edges finely serrated, having a partly rotary motion about a point central to the three. The medicinal leech has two rows of serrations on each jaw.

"Among the crustaceans—lobsters, shrimps, crabs, etc.,—the maxillary organs are but modifications of entire limbs translated from the locomotive series and set apart as special mouth organs. . . . In the higher crustaceans the

anterior part of the stomach is provided with certain masticatory appendages or stomacholiths, often termed teeth, though more analogous to a sort of a calcareous gizzard. These consist of several calcareous pieces, moved by appropriate muscles inserted in the membranous wall of the stomach, armed with a smooth medium plate and lateral molar-like organs, whose mimetic resemblance to the molar teeth of some forms of mammalia affords a beautiful illustration of the way, through the selective influence of similar functions, analogous structures may be built up in organs which have no homology whatever. Two smaller points, bicuspid in the lobster, tricuspid in the crab, complete the calcareous apparatus.

"Among the schinoderms, the sea-urchin has a remarkable apparatus called "Aristotle's Lantern," which contains what may be fairly regarded as true teeth. . . . It is very complicated in its arrangement, but in essentials consists of five hard, calcareous wedge-shaped sockets or alveoli, each containing one porcelainous chisel-shaped tooth. The teeth are, like those of rodents, usually worn more on the inner than on the outer side, and therefore in wearing always preserve a sharp edge. The combination of the teeth and alveoli produces a pentagonal cone, the apex being formed by the coming together of the points of the teeth. In life this cone is concealed within the tissues, only the points of the teeth projecting."

Not many of the Mollusca are provided with teeth; the entire group of Acephala (the headless molluscs, such as clams, oysters, mussels, etc.), are entirely without head or dental apparatus. And not every one of the Cephalopoda (whelks, snails, periwinkles, etc.,) are provided with teeth, but most of them have such organs. When they are found they are arranged on the "odontophore," a chitinous band upon which the teeth are set, pointing upward and backward like the papilla on a cat's tongue, and it grows out of the radular sac in the floor of the gullet. The floor of the sac is carried forward, with the radula upon it over an arched, cartilaginous mass called the buccal cartilage, and down to the front edge, immediately behind the mouth. This serves as an elastic pad which may press the denticulated surface of the radula against any object to be torn or cut. This is controlled by muscles which draw it backward and forward, or even protrude it, as can be seen in the common wood snail, in which the pink buccal mass is pushed forward to seize and cut food. In the snail the number of these teeth is remarkable, 12,000, to 40,000 have been counted on the saw-like lingual ribbon. It can cut grass or leaves sharply off. As the teeth are worn off the ribbon, it is uncoiled, and new teeth are thus brought into use. The upper part of the mouth is lined with a horny substance, against which the sharp-toothed tongue works with a

rasp-like motion. The tough leaves of the lily may often be found cut by the snail's lingual ribbon.

"The teeth on the strap-like odontophore are varied and remarkable in shape and size, and are difficult to examine, as some of them are very minute and hard to dissect out and study. They are usually composed of a base, a shank or stem, and a cutting edge, the latter simple or variously denticulated. The form of the cutting edge is varied, the carnivorous forms usually having simpler and more claw-shaped teeth. When arranged in rows, as they are in many forms,—the middle row is called the median or *rachidian* teeth, and the lateral rows, the lateral or *pleural* teeth. The latter are usually right and left.

Sometimes there are teeth outside of the lateral rows which are called the *Uncini*, and are flat, plate-like, or slender, spiny teeth. They may be very numerous, as in the vegetable feeding snails, or wholly absent in other forms."

There is much to be observed about the teeth of the snails and their allies, and the field offers a profitable opening for investigation. They are already divided into classes by an elaborate system of arrangement, but much remains to be done in describing varieties. "The adult perfect teeth vary from nearly transparent to an amber yellow or reddish brown, and sometimes the cutting points are black. In any large whelk they are easily seen, and in a large cuttle fish the radula may be an inch wide. On the other hand, in some small land snails, where the whole shell is not larger than a pin-head, high powers are necessary to observe them. . . . The highest type in the system of classification is called the *Toxoglossa*, or arrow-toothed, from their narrow, round form, often barbed, and sometimes hollow to inject poison—as in *Belaor Conus*.

Next come *Rachiglossa*, having only rachidian teeth, as in the common whelk. The teeth are usually slight and varied, and prettily denticulated on the cutting edge. The next is the *Taniglossa*, bent-toothed, including the greater part of the fresh water snails. The *Ptenoglossa*, feather-toothed, are a small group, of which the sea-laria is a member. The *Rhiphidoglossa*, needle-toothed, comprise a large number of sea-snails, and a few operculated land snails. The last is *Docoglossa*, chevron-toothed, and includes the limpets. Some snails present a pavement-like form and arrangement of teeth, which are often of a very pretty pattern, or again a mere hardened mass.

We have thus given briefly the outlines of a study of the teeth of invertebrates, merely to indicate the extent of the subject, and to suggest the interest and attractiveness there is in its pursuit to the naturalist; and in addition to this, to suggest that the study of invertebrate odontology has a positive value to the comparative dental

anatomist, from a philosophical standpoint. As a leaf from the great book of Nature, it unfolds to us many of her beauties and wonders, and it is also pregnant with suggestions to the dental student who follows his subject out into all of its branches. So we find in this branch, varieties of form and adaptation to purposes which are not paralleled in the vertebrates. The study of their forms and fitness to perform particular duties, is full of interest and surprises, in the fertility of design which Nature exhibits. Then the analogies presented are very interesting, as in the case of the cuspidate teeth of the stomacoliths of the crustacea, which resemble vertebrate grinding teeth, and show that similarity of function often develops similarity of form, even in dissimilar parts. Of homologies with vertebrate teeth, there are few, as the jaws of the articulates work horizontally and those of vertebrates vertically. In the few instances of invertebrates which have vertical jaws, those parts are armed with beaks and the teeth are situated further back on the odontophore. The teeth of the sea-urchin have true sockets and alveoli, but their arrangement, support, and motion are very different from those of the vertebrates. So that taken altogether, the class presents few homologies with vertebrates, or even resemblances to them, and thus affords a variety of illustration that the latter does not supply.

Dr. Talbot: You have all heard Dr. Thompson's paper read by Dr. Marshall. Are there any remarks?

Dr. Whitefield: There is very little I could say on the subject. Last summer I was very much interested in the study, and I have some teeth at home which I think are nearly three-eighths of an inch long and the arrangement is very beautiful. There is a little skeleton-like arrangement something like a trap, coming to a point, and the tooth presses down over that point. They all work separately.

Dr. Rusk: A few days ago, I saw a specimen which I would like to show here, and will bring here some time during the session. It is a very large tooth that was sent here by some chief in the west, and the remarkable part of it is that the enamel is black or almost black. It is a very immense tooth with very short roots. I think it is a very rare specimen.

Dr. Talbot: As the sessions are to be very short and we have to leave the room at half-past five, and as there are a large number of papers, it would seem to be a good plan to have another one this afternoon, so as not to crowd them in the last session; and I would suggest that Dr. Marshall read his paper.

Dr. Andrews: I think it would be better to have Dr. Marshall's paper held over until another meeting. It is an interesting paper and there will be more members present.

Dr. Talbot: What is your pleasure in regard to the matter? I would suggest adjournment.

Dr. Marshall: I move that a nominating committee of three be appointed, to nominate officers and report to-morrow afternoon. Seconded and passed unanimously.

Dr. Talbot: I appoint Dr. Marshall, Dr. Taft and Dr. Williams. The motion to adjourn is now in order. Seconded and passed.

WEDNESDAY, MAY 6.

The meeting having come to order, Dr. Talbot occupied the chair.

Dr. Talbot: The first order of business this afternoon will be the election of officers. According to the Constitution and By-laws, officers are to be elected the "second day of each annual meeting." I believe a committee was appointed to attend to the matter, and as this is the time for that order, we shall have to take it up at this hour. Have the nominating committee any report to make?

Dr. Marshall: Mr. President, the committee has not been able to get together yet, but we will make a report after the discussion closes.

Dr. Talbot: If there are no other committees ready to report, the next order of business will be papers from Dr. Geo. S. Allen and Dr. E. Andrews.

(Dr. Allen here read his paper, after which he illustrated the same by stereopticon views.)

THE GENESIS OF THE CONTOUR FILLING.

BY GEO. S. ALLEN, D.D.S.,
OF NEW YORK, N. Y.

So generally accepted is it by the profession at large that the contour filling represents the highest development of the art in conservative dentistry, that it is as much as a man's reputation is worth, to say a good word for the old-fashioned face filling of years gone by. Practice and precept, it is true, do not always follow the same road; still it is a healthy sign of growth to see the highest ideal kept well in the foreground in all our discussions and writings. No subject has been so well and so ably handled by the wise men in our profession, as the one that presses the claims and advantages of contour work. So true is this that he who would start on the hunt for one single brand new thought or idea on the subject, would have a weary road to travel and have little to show for his time and trouble when he came to foot up his returns.

At the best he could only hope to attract attention by giving some more beautiful or apt illustration to some well-worn idea or principle that had already become the common property of all. So I turn aside from this uninviting field of labor to another—one more practical, and I hope therefore more interesting, and will confine my thoughts