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Sinanodelphis izumidaensis, a New Miocene Dolphin of Japan

By

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With 2 Text-figures and Plates I–III

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First Words[1]

Remains of Cetacea are not uncommon in the Tertiary of Japan, but the greater number of these fossils are bits of vertebrae or other bones which names in science are hardly be made clear. For that reason, but for accounts of some teeth of *Ontocetus*, *Kogia* and *Pseudorca*, a rostrum of *Eurhinodelphis* and a part of skull of *Idiocetus* given by Prof. H. MATSUMOTO, our knowledge on this group of animal in the Tertiary is very poor.

Discovery of *Sinanodelphis izumidaensis* n. gen. n. sp. a fossil dolphin in May, 1934 from the Miocene Bessyo shale in Nagano-ken (Sinano Province) made a very important addition to our knowledge of these animals. It was in a flat boulder of the shale about 2m. in diameter which was among talus débris in a small valley Zyagawara right under Dainitidô a house of religion in Izumida near Ueda. While men were in work to make better the small river, the boulder was cut to parts and the bones came out. The boulder is no doubt a calcareous concretion made in the black shale about the fossil and possibly it had been in a higher level. Without doubt the fossil has been got from the Bessyo shale which geological age is the early Miocene with some special Mollusca such as *Adulomya uchimuraensis* KURODA, *Thyasira bisecta* CONRAD, *Pseudamusium besshoense* KURODA and some others.

The representatives of the country town kindly gave me way to work in palæontology on this important fossil through good help

1) in Basic English.

by the late Mr. S. KOYAMA, who, in addition, gave me many suggestions in the field work. Prof. T. KOMAI, of Kyoto Imperial University kindly let me see an example for comparison and books in the school of zoology. The camera-pictures were made by Mr. N. TAKAHASI. Mr. H. KATÔ gave me help in making up of the example. The work would have been very hard without the kind acts of these persons. A warm sense of debt to Mr. K. HONDA and Mr. H. UTIDA, who kindly let me see the examples of Cetacea kept in the Tokyo Science Museum, has to be put into words.

Preservation of the Fossil

The fossil dolphin is not complete being made of the skull with mandibles and hyoid bones, 7 cervical vertebrae, 11 thoracic vertebrae with the neural arches and some of the ribs, and the right arm with hand. Most probably the animal had been resting on the sea floor with its left ventral side down, so that the neural arches are seen to the left of the line of centra and the mandibles to the right of the cranium on a bedding plane of the shale in which the fossil has been taken, while the left ribs are stretched on to the natural side of the thoracic vertebrae.

The fossil is in two divisions: top and lower, the plane of division being a bedding plane. The top bed material, to our great regret, has gone to smaller bits, of which some were damaged, but still a small number of the higher parts of the bone framework are present. The lower bed are in 4 parts, on which faces we see the cuts of the bones kept in the stone substance.

Petrification is in a very high degree: all rooms in the sponge-like structure are made full with very small crystals of calcite and argillaceous mass; and the substance of bone itself has been changed into calcite. Because the fossil is softer than the stone which is made harder with calcareous material and aggregations of pyrite, and the faces of the bones are united with the stone substance very tightly, it is not a simple work to have the bones free from the mass of the shale.

The phalanges, hyoid, scapula, ribs and some other parts were covered by a coating of argillaceous substance which were taken away in the work, so that the top view became more nearly complete. Natural position of the concretion in the beds is judged by this thin coating of the shale wich has taken place on the bone after the death of the animal.

Details of condition will be given later with the account on every part of the bones. It is not possible at present to take away the argillaceous substance in all from the fossil without a loss of bones. Bones which are not very strong, for example, the higher part of the cranium, cervical vertebrae and scapula were crushed and broken. Observation of such complex group of broken parts on a bedding plane is naturally very hard. For that reason, a small number of the parts were not able to be named, for example St of Fig. 1 is not certain if it is truly a part of the sternum.

At the side of the dolphin, there are a number of fish bones and hard skins, about which nothing did come to decision, but for the fact that the same fishes made wide distributions in the Miocene shales of North Japan.

Stratigraphy

The Tertiary stratigraphy of this district was worked out by S. KOYAMA and F. HOMMA who gave an account in Japanese language with details in palæontology by E. KONNO and T. KURODA. A short account of the Tertiary beds will be given under in going up order, the base being the start:

1. Moriya Beds: marine, conglomerate, sandstone, shale and tuff in going up order, the chief part being shale with some poor molluscs ..... 1,200 m.
2. Utimura Beds: marine; the lower part is made of green massive tuff with some unmixed terrigenous beds which come between the tuff; the top part is made of sandstones, shales and tuffs ..... 2,500 m.
3. Bessyo Shale: marine, mostly shale with Pisces, Cetacea and Mollusca. ..... 500 m.
4. Aoki Beds: Conglomerate, sandstones and shales; unconformity to the Bessyo shale is well marked ..... 800 m.
5. Ogawa Beds: marine, not marine in part, tuff and terrigenous rocks with many molluscs ..... 2,100 m.
6. Shigarami Beds: marine, representative of a new (Pliocene) transgression ..... 1,250 m.

The Tertiary of this district seems to be thicker than normal. The beds, however, were mostly made while the Miocene epoch, but for the topmost division being the Pliocene. There is reason which detail will not be given here, that the Utimura Beds are probably

Langhian in age and the Bessyo shale will be the higher level of that stage or a lower part of the middle Miocene.

General Account in short

The new genus *Sinanodelphis*, *S. izumidaensis* n. sp. as the type species by original designation, may be taken into Delphinidae, though it is different in some respects from the living representatives of the family, all the 7 cervical vertebrae being free and much longer. The last quality put that of *Delphinapterus* in mind which, however, is not like the fossil in other points. The skull seems to be like that of *Delphinavus* of California having a high upright occiput which in the two forms makes a sharp angle with the roof of the skull at the top.

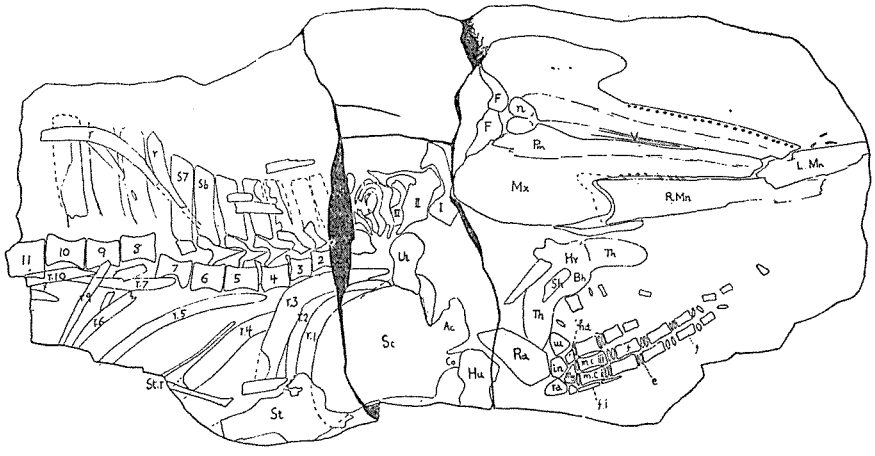

Fig. 1. Bones on the top face of the lower bed. $\frac{1}{10}$

L, left; R, right; Mn, mandible; Pm, premaxilla; Mx, Maxilla; F, frontal; Hy, hyoid; ul, ulnare; in, intermedium; ra, radiale; Ra, radius; Ul, Ulna; Hu, Humerus; Sc, scapula; I, atlas; II, axis; III, 3rd cervical vertebra; 1, 2, 3 etc., thoracic vertebrae; St, sternum; St r, sternal rib; r3, r4 etc., right ribs; S6, S7, neural spine.

The teeth are very small, simple, of equal size and so many as over fourty on one side. The rostrum is as long as in *Delphinus*. The neural spines of the thoracic vertebrae are very high unlike those of *Delphinavus*. There is kept a small number of the ossified sternal ribs. The manus is very long, seemingly the longest of all the Delphinidae in relation to body.

The new genus is separated clearly from other Miocene genera of Delphinidae such as *Delphinodon* LEIDY, 1869, *Kentriodon* KELLOG, 1927 and *Pithanodelphis* ABEL, 1905 by having nearer relations to the living *Delphinus* as will be given the account.

Skull

We are not able to have a complete knowledge of the skull of this new form, for the only one example was put under a very heavy weight to damage of its top part, crushed bits of which were put on a flat bedding plane all together and then it came to two divisions through a crack parallel to the bedding plane. The complex mass of bones were forced to be broken in two. The division on the lower bed put out a poor top view and that of the top bed, though in part keeps the true top face, is covered by the stone substance which is so tightly united with the bones as that there is no way at present to take it away without destruction of the face. For the same reason, it is not able to see the lower view of the skull.

It came short of the front end of the rostrum, so that the true number of teeth and how long the rostrum are not taken in knowledge, though a rough measure made by judging from the general tendency of the outline may not be so far from the true value. In the relation of cranium to rostrum the form under observation is in agreement most nearly with the living species *Delphinus delphis* LINNÉ, 1758 and *Prodelphinus euphrosinae* GRAY, 1901 in comparison with those relations seen in *Phocaena* on one side and *Delphinus longirostris* CUVIER, 1829 on the other side, while it is true that the rostrum is not so long as in the common Miocene toothed Cetacea such as *Eurhinodelphis* or *Acrodelphis*. A different effect in look with *Delphinus* is the higher, more nearly upright occiput which in the fossil at least makes a sharp angle with the roof of the skull at the top, in place of going forward forming the round back part of the roof. In this connection, this form has a greater relation with *Delphinavus newhalli* LULL, 1914 of California, which, however, is smaller in size. Unhappily there is no way to put the skull in comparison with that of *Delphinavus* in detail, because only the side views of the second has been given.

The outline of the cranium is almost a square wider than long. It is widest at about the middle getting a little narrower to the round back outside angles. The maxillae and premaxillae make the greater parts of the top face, specially the first, which make the two sides of the skull covering completely the outside edges of the frontals. The antorbital notches are more or less deep, being a little deeper than those of the living *Delphinus*. The flat expansions of the maxillae at their back parts over the frontals are as normal of the living

genara in near relation, but their front apophyses (antero-external) go more forward and there are long stretches going back to the back side of the skull on the two sides coming in touch with the supra-occipital for a short way through.

The two out edges of the maxillae on the well marked off rostrum are nearly straight all the way through, but for a very feeble tight feeling at about 5 cm. in front of the antorbital notches. Farther forward the sides may be said to be straight in the limited sense, giving a look that the two lines will go across one another at a point which distance from the base of the rostrum is about 31 cm. The true distance from the base to the front end would be far less than 31 cm., because the front edges of the maxillae as seen in the top bed material are curved out from a point at a distance 23 cm. from the notches, though the very end would have been narrow and sharp like in *Delphinus delphis.*

The premaxillae are narrower than the maxillae all through the rostrum. The top face is flat and not sloped, but for the farthest end which is not seen having been taken away. This part seems to have no tooth as seen in a poor bit of the left one in the top bed material; but it is not good to go on with the statement, because a fact premaxillae without teeth is one of the most important special marks. Of the lower bed example, the premaxillae put out cuts through the bones short way down from the top. In and out sides of these cuts go for a more or less long way from the front end parallel to one another, the two insides edges being nearly in touch. At a point about 13 cm. in front of the antorbital notches, the mesorostral groove comes in view on the cut face, getting wider and wider going back to the nose openings. The groove is widest at about 5 cm. in front of the nose openings measuring 16 mm. from side to side, and then it is narrowed again farther to the back, as the premaxillae, forming two equal wide angles, are almost in touch in front of the nare. The wider back part of the groove has nothing but very hard mineral substances in it, while the narrow front part is made full by bone substance which is of the vomer making the base of the groove. The edge of the vomer is well marked by two thin dark lines having a meeting with one another at a point quite near the seeming start of the groove. It is highly possible that the mesorostral groove is narrowly open all way through in front of this seeming end, the lower parts of the premaxillae being the floor.

The back parts of the premaxillae on the cranium are not very

clear having been crushed with a great loss of the faces, but it is certain at least that the right one goes farther back coming to touch with the right nasal. They are made wider on these parts in the same way as in *Delphinus.*

The top face of the cranium seems to have been nearly flat and sloping forward not very strongly. while the expansions of the maxillae have been sloping to the outsides very little and the faces in the example are curving down right over the roof of the temporal fossae. There is a long and narrow hollow made full with argillaceous substance near and parallel to the inside edge of the back part of the left maxilla. This is a produce after the death being a broken hollow and the crushed bits of bones—mostly of the maxilla—have been taken away or falled down before the fossilization, because there is no such hollow on the equal place of the right maxilla though it is crushed at that place where the maxilla is curving down very little over the temporal fossa. The hollow of the left seems to be the falled roof over the top angle of the temporal fossa. There are seen in this hollow some small bits of bones, of which a long one near the left angle might be a part of the frontal and the other long one near the right edge be the parietal. Not a foramen is kept clearly on the maxillae and premaxillae.

The nasals and frontals made open to the top face are put in a not so wide space between the two back stretches of the maxillae. In the top view of the lower bed, detailed limits of the higher bones in the damaged back space do not come to decision without any doubt. The nasals have been taken away from the lower bed example by the crush, but a small bit of the left is kept in another part of the top bed. To the back of the nose holes, there is seen a cut of the mesethmoid which is put limit by four equally curving in edges. No more detail of this bone is necessary to be given here. The nasals, in addition, seem to be not so far different from those of *Delphinus,* the left being narrow and the right round judging from the feeble wounds on the frontals, though the true outlines are not well marked. The left frontal coming into view which front part has been covered by the maxilla is quite small and narrow. It is made longer going to the back outside angle. The suture with the supraoccipital is curving in, specially strongly in front. The open part of the right frontal seems to be a little wider than the left if the back inside edge of the maxilla which come over the frontal is not broken. The two frontals to the back of the maxillae come into

the top view as if they are strange nasals unlike the normal forms of Delphinidae. At first look I took them so, but after observation with care I was conscious of that they are truly frontals, for the other parts go under the maxillae and they are united with the supraoccipital all through the back sides. The greatest parts of the frontals are covered all over by the cranium expansions of the maxillae and premaxillae, but a long band-like cut of bone near and outside the expansion of the right seems to be unfixed supra-orbital process.

The supraoccipital does not take a great part in the top view, because the upright occiput makes a sharp angle in meeting the top bones. It goes a short way forward forming a round middle back side of the skull into the wide but very short space between the two frontals.

The back view of the skull is not complete. The occipital bones are crushed and no detail is able to be given here. It is possible to say at least that the skull was highest at its back measuring not so much over 18 cm. The inside room of the brain box and the foramen magnum are made full with calcite crystals of great size. The broken parts and cuts of the paraoccipital, falcate processes and occipital condyles, which are not things to be measured without error, come into view anyhow.

Measures :

Longest measure of cranium or distance from back side to level of antorbital notches ..... 17.5 cm.
Widest measure of cranium or greatest distance between out edges of maxillae ..... 22.2 cm.
Longest measure of rostrum or distance from level of antorbital notches to probable front end ..... 24.5 cm. ?
Greatest distance from level of antorbital notches to broken end ..... 23.9 cm.
Width of rostrum at level of antorbital notches ..... 13.8 cm.
Distance from end to end of right maxilla expansion ..... 16.4 cm.
Long distance from inside to outside end of left opened frontal 5.0 cm.
Greatest distance from side to side of nose openings together 4.6 cm.
Greatest distance from end to end of nose openings ..... 3.4 cm.
Distance from end to end of Vomer ..... 20.6 cm.
Distance from level of antorbital notches to back end of left premaxilla ..... 8.8 cm.
The same as the top, but right premaxilla ..... 12.8 cm.
Widest measure of mesorostral groove ..... 1.6 cm.

Width of left premaxilla across front end of vomer ..... 1.4 cm.
Width of left premaxilla across touch point in front of nose opening ..... 3.0 cm.
Probable size of left nasal ..... 2.2 cm. wide, 1.4 cm. long.
How far supraoccipital goes forward on top of skull..... 3.5 cm.

Mandible

The mandibles are very uncomplete having been damaged by the crush from the right top direction. The left ramus is seen on the lower bed with its inside face up in front of the broken end of the maxillae which come over the back part. The right mandible which come short of its two ends is kept in a top bed material putting out its inside on view. On the lower bed, there is a printed mark of the right mandible with thin coating of bone substance in it to the right of the left ramus and parallel to the out edge of the right maxilla.

The right ramus is 24.6 cm. long from the short end to end and 5.5 cm. high at the back. It is quite certain that there is a little tight feeling at about the middle of the lower side. In front of that tight feeling the top and under sides of the ramus are nearly parallel to one another. The left ramus is 3.2 cm. high across the front part. There is no sign of symphysis at the front end of these bits. The symphysis seems to be very short in relation to the rami as in examples of *Delphinus*.

Teeth

It seems highly probable that all the teeth of the left maxilla are kept in the top bed material, though every one of them is not complete at all. There is 45 cuts of the top teeth on this side and 21 to 22 in every 10 cm. This sort of dentition is named 'polyodont homodont' by ABEL, as a great number of teeth are all equal in size. The edges to the back of the tight feeling of the maxillae are free from teeth. A number of teeth have been taken away from their natural places, but for some small number on the right maxilla and mandible. Some other teeth are stretched on the bed near their first positions putting out their complete forms.

Most of the teeth are sloped back and separated by a little narrower spaces than the teeth themselves. One of the unfixed teeth is 11.4 mm. long and 2.1 mm. wide (greatest diameter). No tooth is much longer than 11 mm. and wider than 2 mm. Only the two teeth

at the front end are much smaller, the most front one being 0.9 mm. wide. As has been given before, the premaxillae do keep no tooth. All the teeth are nearly equal in form, being simple a little curved back cones with smooth enamel. A long and narrow root is not marked off from a short and not so sharp crown, but for a not clear lower limit of the enamel which do not get down to the lower part being taken place unconsciously by cementum. A cut of a tooth across the base of the crown is a circle, which middle part made of dentine is 0.6 to 0.8 mm. wide across the middle covered by the outer circle of cementum 0.3 to 0.5 mm. thick. The pulp hole which is very narrow does not go up to the crown.

The qualities of the teeth, as have given accounts of them, are in agreement with those of *Delphinus* in many respects. *Kentriodon* in addition, though much greater in size, has some common special marks of teeth with the present new genus.

Hyoid Bones

The hyoid bones which qualities are not much different from those of *Delphinus* are put out to the right of the cranium on the lower bed. The basihyal and the two thyrohyals are made one; the lines of joining by being made higher are more or less clear on the face. The basihyal or the middle part is higher than wide and has two short cone-like processes (ceratohyals) in front with cut heads which are again made in two heads by a shallow middle notch. The thyrohyals or the two wing-like expansions are curved up and back. Of the ventral face, which is the only view put before us as the hyoid bones are turned over on the bed, the basihyal is more strongly curving out while the wings are flatly so.

The general outline of these fixed bones is not much different from that of *Delphinus*, but for the higher basihyal of *Sinanodelphis* which base goes a short way out from the back curve of the united thyrohyals. The wings are narrower and longer in *Delphinus* than in *Sinanodelphis*, and the base line of the basihyal in the first genus is straight or curving in a little. The back produce of the basihyal seems to be a very special quality of this new species, though it may not be so important as to be taken as a mark of the genus.

Two long narrow and straight rod-like bones made flat by the crush and seen across the united hyoid bones are most probably the styrohyals. They are not very complete, and covered by the right thyrohyal in part from which they are not able to be taken out

without destruction. They were under the thyrohyal at first and then they come out in part from the bone over them through cracks by the crush.

Measures:

Widest distance from side to side of basihyal..... 45 mm.
Longest distance from end to end of the middle part ..... 65 mm.
Distance from base of inlet between ceratohyals to back edge of basihyal ..... 61 mm.
Widest distance from front to back edge of right thyrohyal... 42 mm.
Distance from back inside angle to round end of left thyrohyal ..... 66.5 mm.
Distance from front inside angle to round end of left thyrohyal 88 mm.

Cervical Vertebrae

The cervical vertebrae seem to have been put under a crush which came from the top front direction, so that every one of them in front has come over the one coming after making a complex mass of broken bones put in the space about 12 cm. long between the back of the skull and the top of the thoracic line. The material at hand is made of two poor cuts of this complex mass through some higher levels, one being on the under face of the top bed and the other on the top face of the lower bed. The two separate faces do not come to a tight touch, for there was loss of material from the faces.

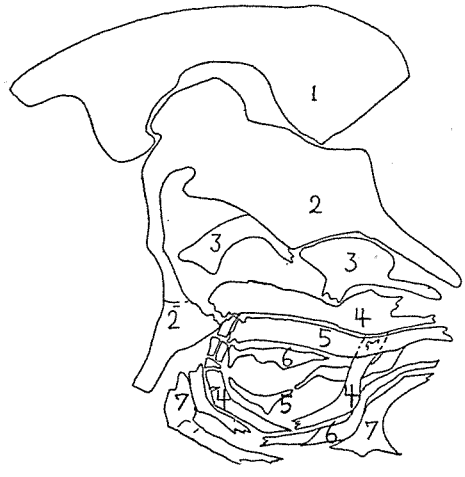

Fig. 2. Cervical vertebrae on the face of the lower bed. ½
1, atlas; 2, axis; 3-7, 3-7 cervical vertebrae.

It is clear that the vertebrae are all free from one another and the cervical line is long for a dolphin being as long as that of *Delphinapterus* by a rough statement, if not so long as in *Platanista*. The atlas is seen only by its picture on the lower bed example. It is as wide as 14 mm. across the middle and 36 mm. across the right part which front edge is widely round and back side is angled with

two straight sides, while no sign of a facet comes into view. There is seen, in addition, a round inlet at the middle of the back and a part of the lower transverse process about 2 cm. long at the left end. The longest distance from side to side of this sloping cut through the atlas together with the left transverse process is 10.5 cm.

The axis on the lower bed example is put out on view by a sloping cut which is the greatest of all cervical vertebrae. The cut of the centrum is a long square with a measure 2.5 cm. by 6 cm. At the two sides of this square, there are seen strong transverse processes, of which the right one is nearly complete being about 3 cm. long and 1 cm. wide at the base. A high neural arch and thick spine are kept in addition, the top being 5.4 cm. high from the top of the centrum. The atlas and axis are not fixed. There is not seen even a bit of an odontoid process which might be had.

The third cervical vertebra is very uncomplete, only putting out the right side angle of the centrum with a short and thin transverse process and the lower parts of the arch. They are covered in part by the nearest bones and some broken parts have been taken away from the lower bed example. The top bed, however, keeps a square outline of the centrum which is about a centimetre in length.

The fourth cervical vertebra on the lower bed gives an upright cut parallel to the front and back faces of the centrum. The centrum is much thinner than the third being 8 mm. wide at the middle (length), but it is quite as long as that of the axis measuring 5 cm. from side to side. The neural arch is broken by a number of not regular cracks and the spine has gone away while the angles of the zygapophyses are possible to be pointed. The top of the arch though not complete is 3.2 cm. high from the base. The right narrow transverse process which has come short of complete form is seen at the right side of the centrum and parallel to the process of the fifth vertebra.

The fifth cervical vertebra is nearly equal to the fourth in size and stretched parallel to it. The neural arch is not complete, being in a worse condition than the one in front, but for the spine which is seen as bits inside the fourth arch.

The sixth cervical vertebra is, in addition, put out only bits of the top part of the centrum, neural arch and right transverse process. The seventh cervical vertebra seems to be a little greater than the fourth to sixth vertebrae. It is kept in the lower bed as badly as in the top bed, only putting out on view its broken parts of neural arch with a sharp angle.

As it is seen in the pictures and account, the cervical bones of the example are a little sloping cuts through the centra and those of the neural arches which are not in their natural places having had falls to back. The neural spine and arch of the axis is the highest and strongest of all being far higher and stronger than the third arch which is the second in size. The seventh arch is a little higher and thicker than those of the fourth to sixth cervical vertebrae which are nearly equally high and strong. The right transverse process of the axis and the third on the lower bed may be the parapophyses while those of the fourth to sixth may be the diapophyses. The sharply pointed angle of the seventh arch would be the spine but not a zygapophysis, if the bit to its right would not be a transverse process.

Of the top bed material, the long and strong left top transverse process of the last cervical vertebra, which has been taken deeply in the stone, is seen on a face of a crack. The transverse processes of the new species are much longer in comparison with those of *Delphinus;* specially those of the middle vertebrae are longer than in the living genus.

Though it is not simple to have knowledge of the detail of the cervical line with such a poor material, we may give reasons with the given facts before us for that the vertebrae are like in some measure those of *Delphinus* but for the united and very wide but short atlas and axis of the second. The free and long vertebrae of *Sinanodelphis* unlike those of *Platanista* or *Inia* do not have so thick, wide and low arches and processes. What is more is that the vertebrae all together are not so long as in those genera, but they are almost equal to that of *Delphinapterus* in the relation to the body. Because the example is not very complete, no regular measure without a great error was able to be taken.

Thoracic Vertebrae

There are 11 thoracic vertebrae in a distance of 40 cm., but nothing more. The centra are long and narrow like those of *Inia* but unlike the short ones of *Delphinus.* The neural spines are very high, wide and upright over the centra as in *Inia,* in place of being sloping forward as in normal *Delphinus.* In this connection, the present genus is like *Delphinavus* in part which is said to have long centra but very short spines.

The example is made up of the top and lower bed materials.

The first material is not so complete having been broken to bits, of which only three are at hand, but it still keeps faces of some spines and centra in part. The second material keeps nearly complete outlines of 11 vertebrae without taking account of the arches and processes which only put out some cuts of them.

Probably a part of the first thoracic vertebra which comes into view on a face of a crack across the back end of the cervical line is the facet for the capitulum of the left second rib. The crack is wide here between the cervical and thoracic lines with a loss of bone substance from the first and second vertebrae. The small second vertebra is put on the example by its back part of centrum and not very complete spine.

Step by step increase of the sizes is well marked by the front five vertebrae, while the vertebrae coming after the fifth are nearly equal in size. All the centra put out on view their right side faces or cut forms through them near the faces, because the animal was resting on the base of the sea with its left side down and then the vertebral line was moved by the crush or some other reason acting on it. The epiphyses are well united with the chief parts, but for those in front of the fourth and fifth centra which have got through the places a short way up.

Measures: (in mm.)

Centra	III	IV	V	VI	VII	VIII	IX	X	XI
Length of centrum with two epiphyses	31	32	37	40	41	41	43	45	47
Width of centrum at its back end	28	33	31	?	35	35	34.5	36	
Least width at the middle of centrum (not in equal condition)	18	26	24	29	17	21	24	25	19

Neural spines	II	III	IV	V	VI	VII	VIII	IX
Distance from lower suture to top	60?	68	?	71	78	84	97	105
Distance from end to end at base		26	25	27	29	27	38	?
Distance from edge to edge at the middle (narrowest width)				23	23	24	25	26
Distance from edge to edge at top					25	28	28	
Length of top edge					28	32		

Three neural arches, every one having a prezygapophysis, are seen over the fourth to sixth centra, but those of the other vertebrae are very badly kept in the materials. The neural spines are not fixed tightly to the arches. The spines of the back vertebrae are higher, wider and more upright than those in front. The tops of the fifth to seventh spines are cut with a forward slope, while that of the eighth is round and the others coming after seem to be the same as the eighth. The slope of the connection line of the tops of the front 7 spines is sharper than in *Phocaena communis* LESSON, 1827, if it is not like that of *Grampus*.

Not a transverse process comes into view. Possibly they are kept deeply in the hard stone if they have not been taken away.

Ribs

The ribs again are not complete and most of them are broken in one or more places. All the right ribs which are kept in the material are stretched on to the right-hand side of the thoracic vertebrae and a small number of broken parts of the left ribs are in the left-hand side covered by the neural spines in part. It is not able to see how long they are and how the ends are made. The four right ribs in front are much wider than the other coming after, the third being 32 mm. wide at the angle, the fourth 32 mm. wide at the widest lower end. The heads of these front ribs, though not very clear, are two headed. The bits of the first two ribs come over one another, only putting out very poor outlines of them. The angle of the third rib is clearly seen near the third centrum and it is over the top part of the fourth. The narrow but long ribs from fifth to eleventh in addition do not keep their heads and ends.

The thin and long bones, two of which are seen near the broken end of the right fifth rib and one more under the sixth and seventh ribs, seem to be most probably ossified sternum ribs, because we have no other bone of such forms in such places in mind. It is not necessary to give accounts of the badly kept left ribs here.

Scapula

The right scapula is seen in two thin divisions on the faces of the top and lower bed materials resting on a short distance off from its natural position. The top edge is kept in the top bed and the coracoid process in the lower bed only. The higher and back parts are very badly kept in the two materials.

A rough measure of the distance from the front top angle to the back top angle is 17 cm., and that of from the top edge to the base (height) is more certainly 13.5 cm. No quality of the face is certain, but for the acromion ridge which, however, has been put together with the flat face by the crush. The distance from the top of the acromion ridge on the top edge of the scapula to the front end of the base is about 14 cm. The outline and face of the curving in base (semicircular facet for the humerus), which is about 5 cm. long from end to end, is clear in some measure.

The coracoid process is not broken being deeply put in the lower bed, but unhappily its front end being covered by the humerus and its top edge being put under the acromion process, the complete form is hardly made clear of the stone substance. The acromion process is wide but not much produced forward. It is 36 mm. wide across its base and about 4 cm. long measuring from the level of the base to the front edge. The distance from the front top angle to the lower angle is 53 mm. The coracoid process, which seems to be narrow but long, is seen right under and a little inside of the acromion process. It is about 20 mm. wide across the base. There is not a notch: even a very small sign of a notch is not marked between the coracoid process and the front angle of the base. The inlet on the top of the acromion process is very deep and sloping.

The given facts before us may be judge of the relation that the scapula is the nearest to that of *Delphinus* among the living genera, from which, specially from the scapula of *D. delphis*, however, the present one is different being shorter but higher in relation and having the shorter acromion process, and having no small notch under the base of the coracoid process. Unlike in *D. delphis*, the front top angle is pointing forward but not down. The scapula of an example (M266, Tokyo Science Museum), which came from Izu with a name *longirostris* like a picture of a scapula given by VAN BENEDEN and P. GERVAIS with a specific name *roseiventris*, is not very different from the present material under observation in its general outline, processes and not notched base. Among the fossils, the scapula of *Delphinavus* again has many marks in support of the near relation with the present form.

Humerus

The right humerus in the two divisions is seen between the scapula and radius. Though unhappily a part, which is the probable

top (proximal end), has not been taken in the material, it is quite clear that the humerus is greater in size by comparison, being as long as the radius, than in the living *Delphinus*, as one might make out so for a fossil form low in evolution. The widely round end seems to be the radial facet though there is no right fact in support of it.

Radius and Ulna

The right radius and a part of the left radius are present with the hand. Only the right ulna, which is again in the two divisions, is at hand. Outlines of these bones are not much different from those of *Delphinus*, not taking into account that in place of being parallel as in *Delphinus*, the two bones would have been separated by a wide space judging from the strong inside curve of the ulna. The broken olecranon of the ulna has gone away; but possibly it might have been a very small one like that of *Delphinus* as the outline at its base put out the almost same tendency as the second. A clear mark of the epiphysis on the widely angled distal end of the radius is seen in the example, almost the only clear sign of one in the all bones of arm.

Measures:

Humerus: how wide at proximal end	4.8 cm.
Radius: how long with epiphysis together	9.3 cm.
Radius: how wide at distal end	4.2 cm.
Ulna: how long	7.0 cm.
Ulna: how wide at proximal end	4.2 cm.
how wide at distal end	2.7 cm.

Hand

The right hand which is turned over on the lower bed is seen to the right with a small loss of bone substance from the face. Broken parts made of the left hand bones are present in addition. The most special mark of the hand is that all the bones are made so much longer than those of *Delphinus*, which keeps the nearest look, as the hand all together seems to be very long, possibly the longest of all Delphinidae by comparison.

The details in outlines are not much different, though longer and narrower, from those of *Delphinus*. The radiale and intermedium are formed with five sides, and the magnum takes a very important place being a wide but low bone (transversely long sphenoid).

All the bones of finger are narrow but long. They still keep separate lenticular epiphyses on every two ends. Some of the distal phalanges have been taken out from their natural positions and sent in all directions. Many unfixed phalanges and epiphyses are seen on the lower bed material, but they are unable to be named rightly.

The first finger is made up of two very narrow and thin phalanges; but the metacarpal is much shorter than those of the other fingers and much wider than the phalanges of the top; it has a look as if it is one of the carpalia. I am not able to make a decision if this last bone is the metacarpal as the general opinion or it is truly the first carpale giving support to the other view. The small thin first finger of this form seems to keep something in common with that of *Globicephalus*, while it is not like that of *Delphinus* in look which is a short pointed form.

The second finger keeps 4 phalanges, the third does 5, and the fourth 3 in their first places or taken out not so far from there. The fifth finger which might be a short one has gone away. As a normal rule, the second would have been the longest of all the five fingers.

The left hand material is only a small part of it, putting out a good view of the carpus in part.

Measures:

Distance from side to side of intermedium (width) 26 mm. in right.
Distance from side to side of radiale ..... 21 mm. in right & left.
How high top of radiale: upright distance from base .....
..... 17 mm. in right & left.
How high distal edge of intermedium .....
..... 21 mm. in right, 20 mm. in left.
Distance from side to side of magnum: how long the front side
..... 24 mm. in right, 25 mm. in left.
Distance from inner edge to out angle of ulnare: (greatest diameter)
..... 21 mm. in right.
Distance from inside to outside of hamatum .... 15 mm.
Distance from base to top of hamatum ..... 16 mm. in right.

Tables of fingers (in mm.)

1st finger	phalanx 1.	2.
length	22	18
width	4	2

2nd finger	metacarpal	phalanx			
		1	2	3	4
length (without epiphysis)	32	30	26	21	17
width (least, at middle)	14.5	14.5	11.5	11	10
length (with epiphysis)	40	39	38	38?	30?

3rd finger	metacarpal	phalanx				
		1	2	3	4	5
length (without epiphysis)	34.5	29	23	18.5	16.5	14
width (least, at the middle)	14	15	12.5	13		8
length (with epiphysis)	44	41	35	31		

4th finger	metacarpal	phalanx	
		1	2
length (without epiphysis)	26	19	12
width (least, at the middle)	17	12	9
length (with epiphysis)	36	27	

Short Observation

The example under observation is a dolphin in near relation to *Delphinus* and *Delphinavus* and it is, for that reason, of the family Delphinidae. The important marks in common with *Delphinus* are as coming after: size, relation of rostrum to cranium, general forms of bones of skull, hyoid, teeth, about four two-headed front ribs, ossified sternum ribs, scapula and general qualities of pectoral extremities, specially manus. The signs low in development are straight occiput, free cervicals, small atlas and axis, long thoracic centra and long humerus. The most special mark of the new genus is the very long pectoral extremities though it is not certain how long they are in relation to the body. The long but narrow hand and finger bones are out of all comparison.

Sinanodelphis is clearly in connection with *Delphinavus*, but these are not early forms in the straight family line of *Delphinus*, because it has high special marks in different development. It was living in the early or middle Miocene sea of Japan, probably taking food upon small fishes. It is low in development on one side, but

very high on the other side, being made adjustment well to the outside conditions. We see some lower dolphins and porpoises in the Recent than the Miocene *Sinanodelphis* in connection with not so important points.

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Account of Plates

Plate I

Fig. 1. Complete picture of top face of lower bed material. $\frac{1}{8}$

Fig. 2. Detail of the same as fig. 1 in part to put out the cervical vertebrae, hyoid (Hy), right arm and hand bones. About $\frac{1}{5}$ (H., humerus; U., ulna; Sc., front part of scapula; 1, atlas; 2, axis.)

Plate II

Fig. 3. Detail of thoracic part of lower bed material. About $\frac{1}{4}$

Fig. 4. Skull, top face of lower bed. About $\frac{1}{4}$

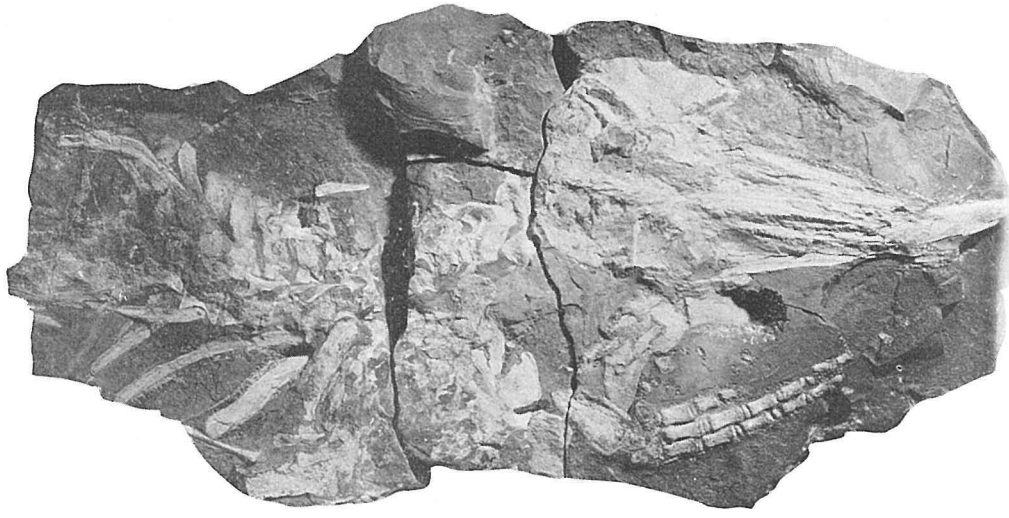
Plate III

Fig. 5. Skull in part, a part of top bed material. About $\frac{1}{4}$

Fig. 6. A part of top bed material with top parts of right hand and arm bones and cervical vertebrae. About $\frac{1}{4}$

Fig. 7. A part of top bed material with thoracic vertebrae in part. About $\frac{1}{4}$

Fig. 8. Part of left hand. (R., radius; r., radiale.)



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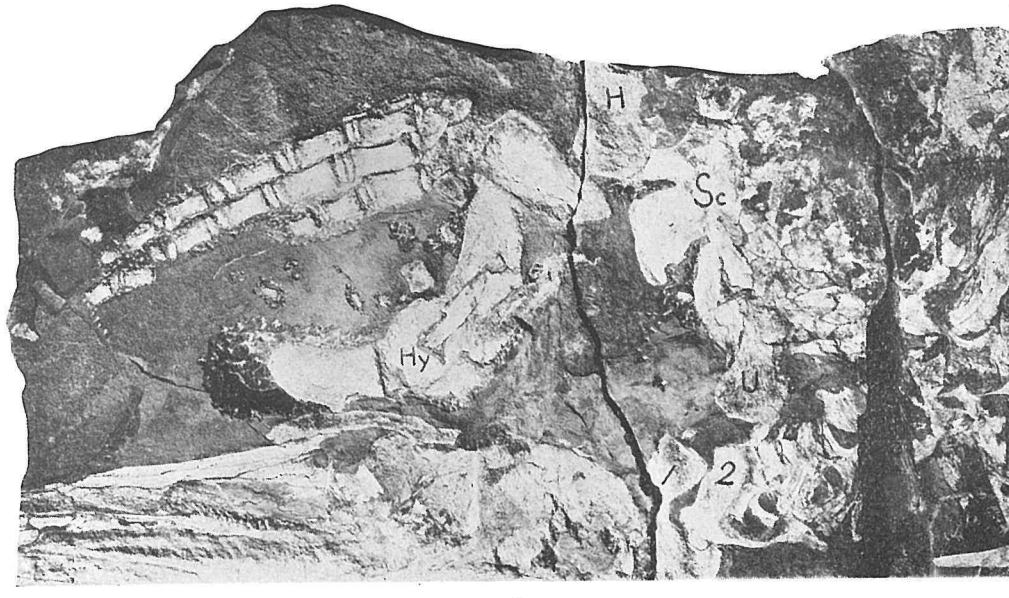

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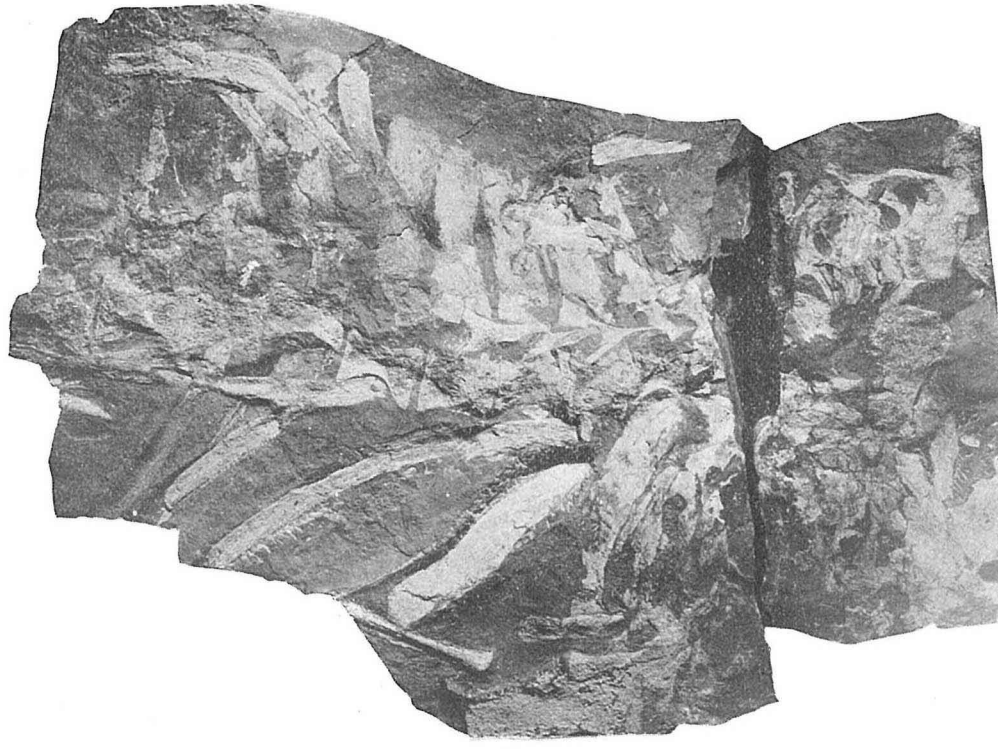

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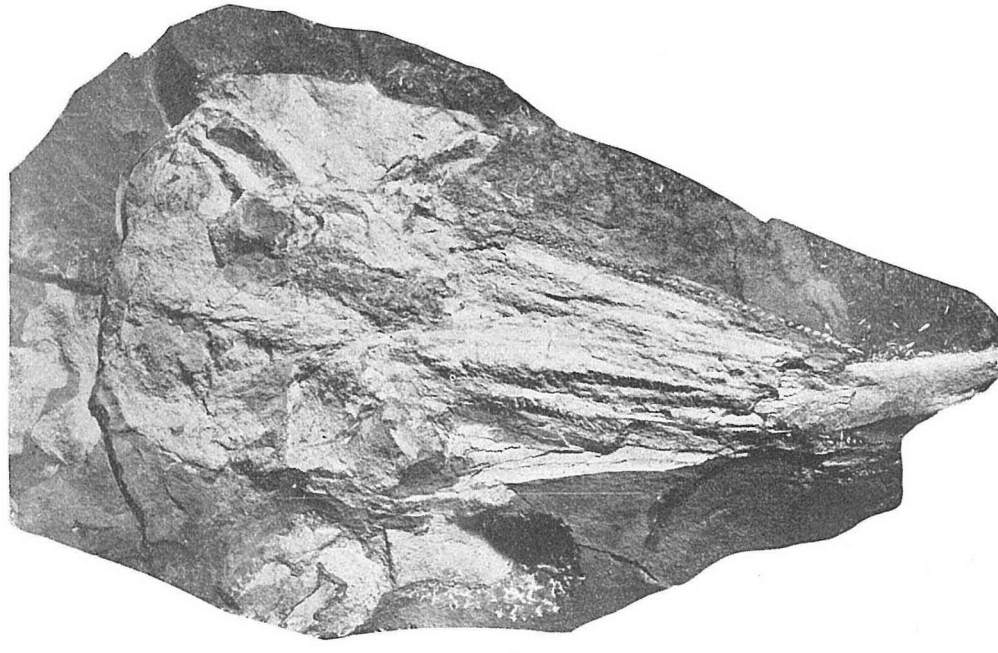

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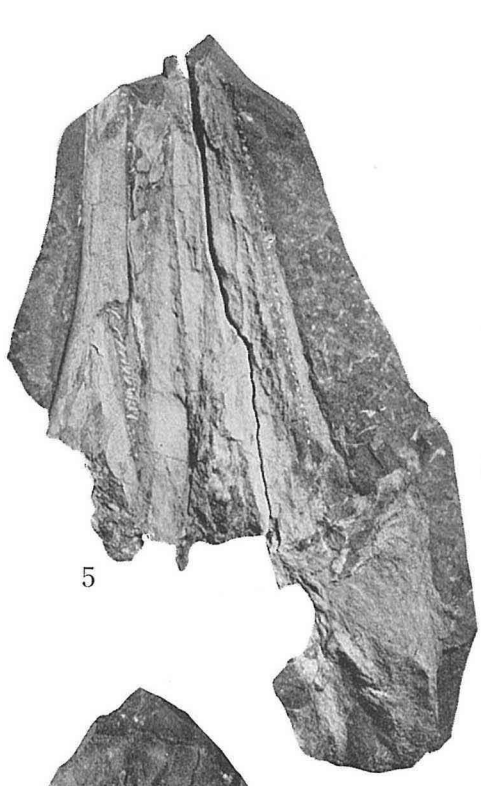

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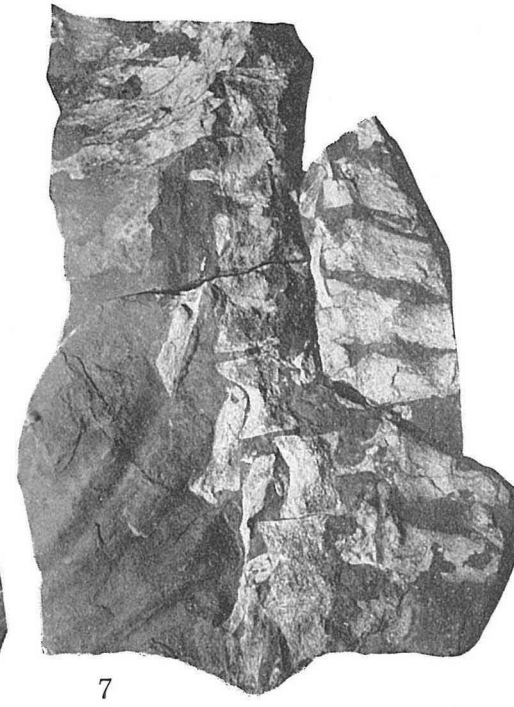

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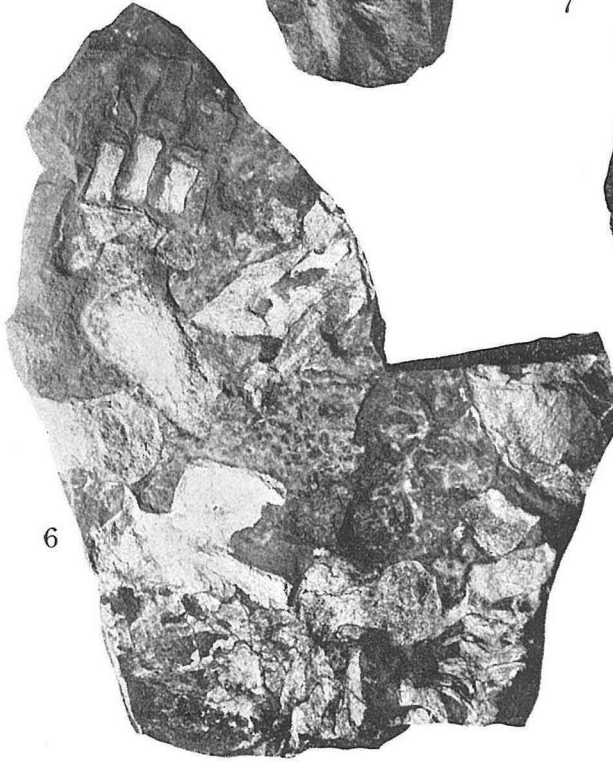

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