The Man Who Invented Music

We all know Pythagoras did quite a lot for high school mathematics; most of us are aware that his "Theorem" is also the basis for trigonometry, and trigonometry is the theoretical background to that most fundamental of sound waves, the sine wave. But that is not even scratching the surface of the work of the Pythagorean School. The man himself, and his own ideas, are only known to us through the writings of his disciples. Yet it does appear that he covered a broad range of subjects and became something of a shining light in all of them. That having been said, however, it is appropriate to admit that the suggestion given, that he and his disciples invented music, is a tad of an overstatement. Nevertheless, short of declaring that the sun shone out of Pythagoras' [fill the blank] on the first morning of creation, he does appear to have been the first to apply a keen, investigative approach, and a mathematically endowed mind, to the study of the acoustics.

This article will spend a little while poking fun at some of his more off-beat assertions and claims. It will also look at the investigations that the Pythagoreans carried out on string lengths. At the time of writing, information on these investigations has been very scarce. As more information comes to hand, it will be added to this essay.

The Man, his Life and his Teachings.

Pythagoras was born on the island of Samos around 582 bc. He became sufficiently disgusted with Polycrates, the tyrannical ruler of Samos, that he chose to exile himself. Tradition states that he travelled first to Egypt and then to Babylon, where he acquired learning in mathematics and pagan mysteries, respectively. (Whether there is any truth in this is doubtful). In 530 BC, he settled in Croton, a small Grecian colony in southern Italy. He then set about gathering disciples to himself – both men and women – in what was to be not only a school of philosophy, but a religious and political movement also. The basic lifestyle orientation of this movement was rather ascetic, particularly by the most common standards of lifestyle and philosophy during the period of Greek ascendancy. (In this, one may include the Stoics, Skeptics, Epicureans and suchlike). They practiced silence, obedience, fasting, simplicity in dress and possessions, and frequent self-examination.

On the other hand, The Pythagoreans held to mystical beliefs similar to those of Orphism. The Orphic cult claimed as its inspiration, the mass of writings by the poet and musician, Orpheus, and upheld a number of the classical stories created by its namesake. One of these stories, which told of the creation of the human race by the deity, Zeus, implied that the human flesh was evil and the human spirit was good. Thus, it gave rise to beliefs of an ascetic nature. Adherents of Greek asceticism sought salvation in a life of self-denial, as the denial of carnal urges was believed to enable the liberation of the spirit. As a musician, Orpheus was said to have been able to cure illnesses by the use of musical performance. Pythagoras, likewise, was said to have been capable of this. But again, tradition asserts some unusual things.
The Pythagoreans believed in the transmigration of souls. Post 1960’s, western thinking draws upon Hindu and Buddhist notions. In such a belief system an impersonal divinity or mystical force, constituted by metaphysical laws, simply operates to move souls about from one life to the next, returning them as different animals, and plants, depending on the goodness practiced in their former life. But to many minds in ancient Greece, the issue was more complicated. Bean stalks, by virtue partly of their tall, straight form, were seen as being particularly important, for souls in departure, as vessels of heavenly ascent. Pythagoras is cited as teaching that to eat beans is an evil equal only to cooking and eating the heads of your own mother and father. The discovery that if one attempts to grow beans in a sealed pot, then the stalks form odd, bulbous shapes similar to a human foetus, contributed to this belief system.

It was with these things in mind, then, that Pythagoras claimed to have been reincarnated from a soldier named Euphorbius, who fought in the Trojan War. Allegedly, in the process of transmigration, he had been granted permission by the gods to retain within himself certain memories of this prior life. That is, as opposed to most others, who apparently had no such recollections. One might consider then that Pythagoras had a very grand opinion of himself. So, by modern standards it might be quite acceptable simply to brush off a movement like this as a cult, apart from its scientific achievements. It strikes me also that it might be quite acceptable nowadays to say that he was full of s____.

During the life of the School, a system of numerology was also developed. That is, a belief that numbers have an intrinsic meaning by virtue of their occurrences in nature, and of their relationship to each other. This might be taken as a mathematical form of animism, raising its head in a culture which had long ago found enough sophistication to move on to polytheism. Their mathematics however well formed and important as it was, appears to have been inextricably combined with this numerology. They studied prime numbers, square numbers, and odd and even numbers, and tied their number theory directly to nature. This mixture of number theory and numerology seems to have possibly provided a dual function. Firstly, of motivating a lot of activity in the realm of natural philosophy, astronomy and applied mathematics. Secondly, of providing a rich seedbed for the development of some very imaginative and intricate extrapolations on the observed universe.

String Lengths and Pitches.

The studies of string length yielded one of the truly useful and enduring discoveries of the Pythagoreans. Having no means for measuring pitch, or a concept of wave theory, the possibilities for discovery were limited. But by virtue of the human mind’s ability to detect consonance, pitch intervals whose consonance are great, such as a single octave or a half-octave, held a natural interest. Anicius Manlius Saverinus Boethius (480-524), a Roman natural philosopher, published a text called De Institutione Musicae translated to English by R. Bruce Lindsay. In it, Boethius appears almost to have come close to furnishing the fundamentals of wave theory himself, which is quite some milestone. In sections 10 and 11, he relates a story of how Pythagoras first took note of the relationship between the properties of a solid object and the pitch of sound that it produces when caused to vibrate. The alleged findings that Pythagoras makes in this account are physically impossible. (See editor’s note below). Boethius, then, would have been somewhat of a third-rate scholar by today’s standards, which is highlighted by the fact that he presents findings based on hammer masses as the immediate starting point for research into string lengths. The story is interesting, though, from other points of view. Firstly, it is a very, very old account on a subject that is
difficult to access. Secondly, it does also provide other cursory information that is more credible. Thirdly, it is a piece of early medieval literature, providing a tiny window on the ways of the post-Roman mind.

Here is the account:

"It was then principally for the reasons set forth in the previous section that Pythagoras abandoned the judgement of the ears and transferred attention to measuring scales, having no faith in the human ear, which can suffer change in part through its own nature and in part through external accidents. It can also vary with age. He had no confidence either in musical instruments from which are often produced great variation and instability. If, for example, you wish to consider strings, more humid air will weaken the vibrations while dry air strengthens them. The large size of the string will produce a tone of lower pitch, while a thinner string will produce a tone of higher pitch. Or in some way, the original state of uniformity may change. Since the same situation prevailed with all other instruments, Pythagoras thought all these unworthy of consideration and had little faith in them. So for a long time he sought assiduously for other means by which judgements concerning consonance could be firmly established. In the meantime, while he was passing a smith’s shop, by the pleasure of the gods, he heard the hammers when struck produce in some way out of the diverse sounds a musical harmony. Astonished at this, which had long been a subject of inquiry to him, he went into the shop and after long consideration decided that the diversity of sounds was due to the force of the blows. In order that he might solve this problem decisively he ordered the men to exchange hammers. But it was found that the properties of the sounds did not depend on the strength of the men, but the same properties were found to exist with the interchanged hammers. When he had observed this he examined the weight of the hammers. Of five hammers, two were found with weights in a ratio of 2 to 1 and these produced sounds an octave apart. He found that the one which was double the weight of the other had a weight four-thirds that of another and produced a sound higher by a forth. One hammer, which had a weight three halves that of another, produced the consonance a fifth above.... Even before Pythagoras the musical consonance of octave, forth and fifth were recognised, but Pythagoras was the first to find by the way just described the proportions associated with these musical harmonies. In order to make clearer what has just been said, let us, for example, assume that the four hammers (the fifth being disregarded) have weights represented by the numbers 12, 9, 8, 6, respectively. Then the hammers with weights 12 and 6 were found to be an octave apart. The hammers with weights 12 and 9 (ratio 4 to 3) are a forth apart, and the same is true of the hammers with weights 8 and 6 respectively. The hammers with weights 9 and 6, respectively are a fifth apart.

"[Editor’s note: the story of the hammers is apocryphal. It was undoubtedly taken by Boethius from much earlier sources. The statements have no basis in fact since the weight of a vibrator by itself has nothing to do with its frequency. It is the geometrical dimensions which, for the same line density and tension (or elastic coefficient) are decisive. The story of how Pythagoras reached this conclusion is explained by Boethius in Section 11.]

"On his return home from the smith’s shop Pythagoras attempted in various ways to find out whether the whole theory of consonant sounds resides in these proportions. He now turned to strings attaching equal weights to them, and judged their consonances by ear. On the other hand he also varied the lengths of reeds by doubling and halving them and by choosing other proportions, and thus by differing observations developed a complete faith in his results.... Led on by these earlier results he examined the length and thickness of strings. And thus he invented the monochord, concerning which we shall have something to say later. The monochord acquired this designation [Latin: regula] not merely because of the wooden scale by which we measure the dimensions of strings and the corresponding sounds, but because any particular investigation of this kind made with a monochord [regula] is so firmly established that no investigation can any longer be misled by doubtful evidence."

The Celestial Music.
As has been said, the investigation of integers and their occurrences, led to the projection of aspects of the natural world into the realms of pagan mystery. Even with the studies on string lengths and pitch, they could not just leave their findings as facts of their world and be happy. The next step was to use their findings to wrap up some other aspect of the cosmos and say something weird about it. It was in astronomy that they eventually found a suitable coincidence.

The astronomy of the Pythagoreans led to the belief that the major celestial bodies were positioned at distances from each other that corresponded to very neat integer ratios. These ratios, in fact, were the same as those noted during string length investigations as producing consonant notes. It was considered that these distances, being as they apparently were, caused some sort of resonance to occur, and that this resonance, being consonant, could be heard as music. This music was not for the ordinary listener, however, as Pythagoras, and Pythagoras alone, could hear it.

And so, through no fault of its own, the very solar system became the next conceptual victim. As to the sort of music it made, one might suppose it to have been something familiar; bouzoukis and the like. But then maybe it was more of an Eno-esque, ambient type of sound. To me that’s more appropriate as planet music.

Conclusion.

Because of the work of the Pythagoreans, the estimation of string lengths came closer to an exact science. As a result, then, the placement of frets on a stringed instrument found a basis in mathematical formulae, rather than mere perception. It might now be easy to jump ahead and conclude that the tempered natural harmonic tuning system was largely the work of this one man and his disciples. This is not so, as the European tuning system that we know today is very complex and was even then still developing. We know that Plato, shortly to come, recommended governmental control over the use and abuse of modular scales by musical performers. All ancient Greek music was based on modular scales at that time, employing only whole-tones, while semitones were unknown. For several centuries to come, each note had its own mode rather than its own scale, and to change key was synonymous to changing mode.

Nevertheless, it does strike one as unusual that this relationship of length and pitch had not been discovered a long time before. Every village bard that ever put his hand to a lyre or harp, with even an ounce of interest in the mathematics of what he was doing, should have seen something in the fact that shorter strings make higher notes. Moreover, the availability of harmonics that sound out when one plays while lightly touching a certain point on a string, should have caught the attention of more than a few. Even more importantly, luthiers and other instrument makers would have been conscious of the best placements for frets, finger holes, and so forth, so as to obtain the most useful selection of notes. Nonetheless, the story handed down from Pythagoras’ own times and onward, points to him being the first to systematise the knowledge and make a science out of it.
Footnotes:
The resources here used are located both in my personal collection and at the central library of Deakin University, Geelong, Australia. One major point of conflict is the origin of, and breadth of belief in, the ideas about beans and transmigration. My own reading has suggested it to have been a fairly common belief among the Greeks, while one of the two the pages referenced above assert that it was Pythagoras' own idea.

Another point of conflict is the assertion of a friendship between Pythagoras and Polycrates (ruler of Samos) while my own sources on that matter state simply that Pythagoras left Samos in disgust against Polycrates. This might have been after Polycrates anulled his alliance with Egypt in favour of Persia. But proof is lacking.

Incidentally, Pythagoras did absolutely nothing for jazz bass. His discoveries can only apply to instruments whose strings differ in length or whose fingerboards are fretted!

Additional Information of Pythagoras
The best information on Pythagoras, his life, and his achievements, can be found via the following two links:
1. "Pythagoras"
2. "Pythagoras of Samos (ca. 560-ca. 480 BC)"

Most, but not all, of the information is in agreement with that below. In spite of discrepancies, the original article is presented untampered, including material not presented in these links. See footnotes for further comments.

http://www.themusicpage.org/articles/Invented%20Music.html