THE DIGITIZATION OF MUSIC IN THE TERM OF MIDI CONCEPT

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Abstract

The concept of "waves" is a common shorthand for major and significant events or developments. Some scientists, for example, worry about the Sixth Wave of Extinctions (Informnauka (Informscience) Agency, 2004). Computer experts think in terms of the Fifth Wave of Computing (Segars, 2019). More generally, waves of technology, and especially electronics, come too rapidly to enumerate (Wallace, 2019). The thesis to be investigated in this paper is that in music, the advent of MIDI marks a legitimate sixth wave of music. In the first part of the paper the history of music will be explored in the sight of six waves. The papers main aim is to clarify the function of MIDI (Musical Digital Interface) in the development of music technology. For this the concept of MIDI term will be researched in the perspective of history and technical sight. The paper will conclude how music was affected from MIDI and what it can bring to the future of music.

Keywords: Music, MIDI, Technology, Music History, Digitization, Digital Music

1. BRIEF HISTORY OF MUSIC

The First Wave of music was almost certainly basic percussion. Sticks, rocks, or bones established a rhythm for use in religious, or at least quasi-religious ceremonies. The status prehistoric societies placed on the hunt, and the ceremonial preparations involved have long been understood. The famous Lascaux Cave Paintings, for example, are presumed to have had significance for success in the hunt (Bradshaw Foundation Staff, 2011). One can presume that ceremonial dance, aided by the first crude rhythm instruments were part of those pre-hunt activities. Echoes of this First Wave music can be seen in Native American and African cultures that still preserve some of the old ways (Hollis, 2017).

1.1 Second Wave

The Second Wave of music is the development of the first musical instruments capable of producing a tone rather than simply a percussive rhythm. It took the Neolithic Revolution, the domestication of plants and animals, of around 12,000 years ago, or 10,000 BCE, to allow the development of permanent communities (Blakemore, 2019). Before that, any instruments would have to be small and portable. It is hardly surprising, then, that the first instruments capable of producing tones were simple flutes produced from the hollow bones of birds (Earliest music instruments found, 2012). These earliest instruments date to an estimated 40,000 years BCE.

Tonal instruments gradually evolved as leisure time was available. By about 4,000 BCE harps and much more sophisticated flutes were seen in Egypt. Another five centuries saw the development of woodwinds and handheld lyres. The first brass instruments, a basic bugle, was developed in Denmark by 2,500 BCE, although the use of various valves to change pitch was still in the future. A millennium later the Hittites invented

one of the most popular instruments in the world, the guitar, with its carefully measured frets to change the tone of a vibrating string. The guitar was the direct ancestor of the various stringed instruments in a modern orchestra, as well as the harpsichord and, ultimately, the piano (Hollis, 2017).

The Second Wave also included the first halting steps toward music being written down. The first piece of recorded music dates to 800 BCE. The cuneiform tablet includes the words to a religious hymn although a method of recording the notes of the hymn remained to be developed. A century later we see the first indications that vocals and instrumentals were combined in the same piece of music. The first musical accompaniment, then, dates back almost a thousand years (Ibid.)

1.2 Third Wave

So much of what we call Western Civilization can be traced to classical Greek culture and specifically to the city-state of Athens. The word democracy, of course, traces directly to the Greek word *demos*, or people. Athens was the first political institution to take laws beyond the simple codification of Hammurabi and evaluating whether they were, in fact legal. They also were the first to separate crimes against property from crimes against persons (Santos, 2017). The Greeks were also musicians of note, not only enjoying the music but using their newly developed scientific methods to parse and refine it. Luminaries including Pythagoras, Plato, and Aristotle studied music and debated its details (Kalan, 2001). The Greeks developed the concept of the octave and within that structure we still see the major modes of octave-based scales - the Ionian, Dorian, Phrygian, Lydian, Mixolydian, Aeolian, and Locrian - developed by the Greeks and given their Greek names. These modes are alive and well in the 21st century as seen in, for example, The Beatles' use of the Mixolydian mode in the song *Norwegian Wood* or the Dorian mode used in the much harder rock song *Smoke on the Water* by Deep Purple (Modes: What are they and how do I use them?, 2018).

The Third Wave continued well into the current era. After the fall of the Roman Empire the church was the principle patron of music. The first music school in Europe, for example, was commissioned by Pope Gregory in 600 CE. Although not germane to this essay, it is interesting to note that anecdotally, the Chinese had orchestras with hundreds of musicians although no written record of that exists (Hollis).
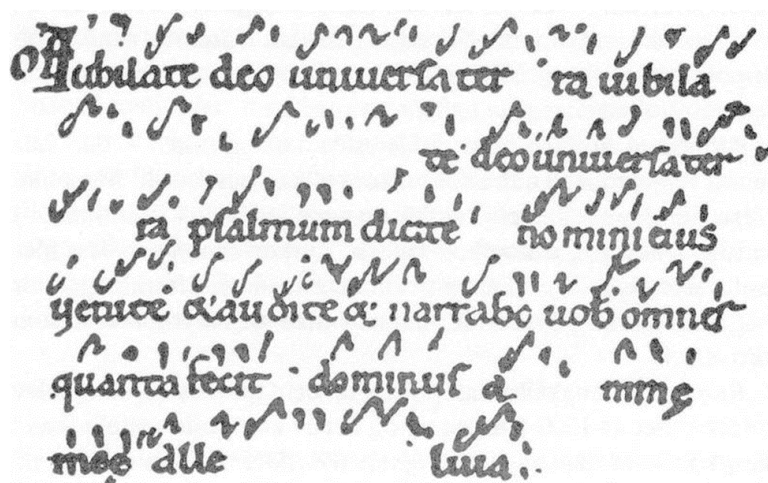
1.3 Fourth Wave

Fig. 1 Neumes (Source: Bennett

The Fourth Wave has an actual date associated with it. In 1025 CE a monk named Guido of Arezzo developed the basic form for writing music that, with some evolution, remains with us today. Before Guido, musical notation consisted of neumes, lines above the words of chants indicating how the tone moved. There was no device, though, to indicate what note was to be sung. Guido invented the solfege, the do-re-mi-fa-so-la-ti-

do vocal scale. More importantly, though, he replaced the neumes with the

staff to identify which notes were to be sung at any point.

This crucial development allowed music to be recreated, with precision, by any musician

who could read the musical notation.

Fig. 2 Early Use of the Staff Source: Bennet

Between the fall of Rome and the Renaissance, church music was the primary source of formal music. Popular music consisted of troubadours, the minnesingers, "singers about love" (Music Timelines, n.d.). With the Renaissance came a rebirth of popular music. The early Renaissance music stuck with the simple forms of the Greek and Romans. With the staff to allow the transfer of music, scores were exchanged, and music became more and more complex. The Baroque period, characterized by formal structure and complex polyphonic scores ran from about 1600 to 1750 (Music Genres Timelines, 2019). This was the era of Bach and Handel and Vivaldi, composers whose music is still played today in concert halls (Top 10 Baroque composers, 2019). The Baroque period was replaced by the Classical period (Music Genres Timelines), with a lighter tone and simpler structure. The Classical period is represented by Mozart, Bach, and Beethoven (Green, 2019). Orchestras grew in size and complexity. The Romantic period rounded out the 19th Century, with Tchaikovsky, Chopin, and Liszt, for example, who are all played today (Top 10 Romantic composers, 2019).

1.4 The Fifth Wave

Once again, we have a firm date associated with a wave in the music world. When Thomas Alva Edison was granted his final patent on the phonograph on February 19, 1878 (Thomas Alva Edison patents the phonograph, 2019), the world of music was changed forever. Before this invention one could spend his (throughout this essay the male pronoun when used as a general descriptor will be assumed to include the female so as to avoid that awkward "his or hers," "him or her," or "he or she" construction) life and hear no music beyond the church choir, performers in a local fair, or a local group. After the phonograph was invented, the world of music as performed by anyone was available.

From its beginning with Edison's relatively crude system using tinfoil cylinders and two needles, one to record the sound and one to play it back, recording "Mary had a little lamb (Hilton, 2017)," through today's incredibly sophisticated electronic systems, recorded music represented an ever evolving method of bringing music to the masses. Tinfoil cylinders, of course, were terribly fragile and had crude fidelity to the original. The next iteration of the technology was the use of wax cylinders, still crude but clearly an improvement. By 1902 the first commercial recordings were available although terribly expensive at $1.00 for a four-minute recording (Ibid.). Flat disc recordings on a variety of materials were mass produced and more durable. In due course mechanical reproduction, on machines popularized by the *Gramaphone* company was replaced by electronics.

Media evolved as well. Wire recorders, making recordings by putting magnetic impulses on thin wire (Wire Recorders, n.d.) were quickly replaced by tape recorders, and when the techniques of high bias recording on magnetic tape were discovered by accident, magnetic tape became the industry standard for making the master recordings of musical performances (Hilton). High fidelity vinyl discs, long playing records designed to be run at 33 ⅓ revolutions per minute, and their single song siblings the 7-inch, 45 rpm record, meant that that masses could own and replay, as often as they chose, the music of their choosing. Vinyl discs dominated the music industry from their introduction in 1948 until they were largely replaced by digital compact discs in 1988.

In the United States, known for its ongoing love affair with the automobile, some form of portable music was a natural evolution. The earliest efforts in this area included record players designed to be used in cars which were produced by Norelco, RCA Victor, Phillips, and Chrysler (Edwards, 2015). These machines, with the requirement that a new record be put in place for every song were quickly replaced by four-track, and then eight-track continuous loop tapes which would hold the equivalent of a long play record. Cassette tapes, smaller and less prone to mechanical failure than the continuous loop system, became the standard portable audio format with a cassette player commonly installed as a stock item in new cars, and portable devices starting with the Sony Walkman became common. Compact discs soon replaced cassettes in American automobiles, and multi disc changers were a common option.

The digital age has been the final step in the Fifth Wave. The uncompressed audio file, a WAV format file (WAV is the common filename extension for a Waveform Audio File Format audio file), contains every byte of information from the original recording. These quickly become huge files and in the 1980s, when digital storage cost $3 to $4 per megabyte, or on the order of $3,500 per gigabyte, a method to compress the files was needed (Ionescu, 2009). The answer was to use a file compression algorithm and generate an MP3 file (MP3 is the common filename extension for files using the Motion Picture Experts Group Layer 3 system to generate an audio file) (Red, 2019). With MP3 files available, small, inexpensive devices, the once ubiquitous iPod and any of dozens of other MP3 players became the ultimate in portable music. Today, so-called smart phones, either the Apple version operated by the proprietary IoS operating system or any of a dozen devices running the Android operating system, using Bluetooth technology, can provide true high fidelity through any modern stereo system. With cloud computing, an essentially unlimited play list can be developed, customized, or any of hundreds of prepared playlists can be used. Services such as Apple Music, Amazon Prime, or Pandora offer millions of songs for a nominal fee. File transfer programs are common. The problem, of course, is that the ease with which these files can be shared means that the composer's intellectual property is more and more difficult to protect.

1.5 The Sixth Wave

Through the first five waves of music we have seen the progress from knocking two sticks together to compound complex orchestras performing outrageously intricate compositions to digitization that allows a full orchestral performance to be carried in a pocket on a portable telephone. In each of these cases, the original performance was accomplished with all of the performers in a single studio, or on a single stage in the case of a live performance. While it is conceivable that the Beatles might have been able to put together *Sergeant Pepper's Lonely Hearts Club Band* with George in India studying the sitar and John and Yoko in New York and Paul moving upscale in London and Ringo trying for an acting career in California, the logistics of moving tape would have made it close to impossible. With the Musical Instrument Digital Interface, commonly referred to as MIDI, such a collaboration would have been a straightforward matter. MIDI is such a powerful tool for musicians it can be considered the Sixth Wave in music.

2. THE TERM OF MIDI: What it is MIDI

MIDI is a digital system the provides an interface understandable to various instruments. It is both that simple and that complex. Before MIDI, in those ancient days of the 1970s when digital electronics in the form of digitized music recording and various synthetic musical instruments were still being developed, instruments and recording devices communicated over patch cords through controlled voltage (CV) and "gates." The CV component of the signal controlled the pitch and any filters being used. The gates, and their quicker firing alter-ego "triggers," established "envelopes" that encapsulated the CV signals, in a way functioning as a carrier signal (Jamieson, 2015). A trigger is a brief burst, often a drum stroke, where a gate is a longer tone, a keyboard note for example. When the trigger or gate is in its energized state, the CV tone is transmitted, when it is in its unenergized state, the CV tone is turned off.

The CV/gate system had some significant issues for musicians though. They were monophonic for one thing, in a stereophonic world. Primarily, they had connectivity issues. If one wanted to be certain that instruments and recording devices would be fully compatible the safest course was to buy equipment from a single manufacturer (Trandafir, 2016). This was clearly unacceptable in a world where personal tastes guided the choice of instruments and recording equipment.

The Sixth Wave, the MIDI revolution, not only has an identifiable birthday, but also has known parents. Ikutaro Kakehashi, then the president of the Roland Corporation, a manufacturer of a variety of instruments as well as recording and mixing equipment, arranged a meeting with Tom Oberheim, a manufacturer of synthesizing equipment, and Dave Smith, developer of the Prophet 5 synthesizer. The specific goal of that

meeting was to develop "a universal digital interface (Trandafir)."

The result of that collaboration was MIDI. The first MIDI, known as MIDI 1.0, was released in November 1982 at the National Association of Music Manufacturers (NAMM) Winter Show in Anaheim, California (NAMM Exhibitor Manual Winter 1982), along with the first MIDI based equipment, the Sequential Circuits Prophet-600 (Trandafir). The NAMM, however, waited until 2013 to celebrate MIDI's 30th anniversary (Future Music, 2012) since it was not until the 1983 show that equipment from different manufacturers, a Jupiter 6 and a Prophet 600 were linked via a MIDI interface (Trandafir).

2.1 What MIDI Does

It is interesting that MIDI has had such a dramatic impact on music since its output has no sound information itself. Rather than sending some sort of an analog signal that will energize the magnets in a speaker, MIDI sends simple digital signals to other pieces of equipment. The technical term is "event messages," each of which is a discrete instruction.

The simplest example is a keyboard connected to a sound module, an amplifier and then to a speaker. When the key on the keyboard is pressed an event message is created which includes data on:

1. Information that a key has been pressed and then released;

2. Information on what note was played;

3. Information on how hard, or how lightly, the key was pressed - the "velocity" of the stroke;

4. Information on how hard the key is held down - separate from simply how long it as held down;

5. Information on the tempo - the beats per minute;

6. Information on the direction the sound should seem to come from - the panning;

7. Information on any modulation; and,

8. Information on the volume at which the note was played (Trandafir: see also Seydel, 2016).

This coded information is then decoded by the receiving unit to reproduce the sound with extremely high fidelity.

2.2 Why MIDI was Such a Revolution

The core of the MIDI revolution is that it provided a truly digital interface. No music, in terms of a signal that will excite the magnets and move the cones of a speaker, is transmitted from the MIDI-out port of the MIDI unit. Rather, a series of information packets are sent that can be decoded by the receiving unit that, in turn, can send the relevant signal to an amplifier and speakers (Lehrman, 2017).

The developers avoided the mistake of Apple in the early days of personal computers. In that early rivalry between Apple and IBM, Apple decided to retain a proprietary hold its operating systems, limiting programs to those produced by Apple. IBM, on the other hand, adopted an "open architecture" approach, making all technical details of the basic operating systems available so that any software developers could develop programs that would run on IBM (and then the whole host of clones that ultimately drove IBM from the market they created) computers (Morris, and Ferguson, 1993). While many Apple users insist that Apple and its operating systems are superior for many uses, especially those which are graphics intensive, the reality is that it is now a PC world. Apple users commonly joke that "Windows (put in your version here) is Mac (put in a version from five or six years ago (eternity in computer terms))," which is an accurate but irrelevant statement. Universities, for example, demand that papers be turned in using a Microsoft Word .docx file format, not in Apple Pages format.

The MIDI developers followed the IBM example and made the MIDI standards free and available on request. A google search for "midi software," for example, yields 458,000,000 returns (midi software, 2019). Refining the search to "midi software free" cut that to a mere 90,000,000 (midi software free, 2019). Clearly the open architecture worked and the problem a MIDI user has today is selecting from among so many choices. Anyone wanting the complete set of MIDI standards simply needs to visit the MIDI Association at www.midi.org, sign up (and you don't need to be a professional musician or an educator to sign up) and download the complete set of specifications. Beginning user is, in fact, an option available on the sign-up screens

MIDI has made an amazing array of tools available to amateurs as well as professionals. Consider the

example of a young person interested in learning to play the guitar. Before MIDI, his parents would buy him an entry level acoustic guitar and if he continued his interest, they would eventually invest in an electric guitar along with a small amplifier/speaker combination. The situation in 2019 is dramatically different.

That initial guitar is available for under $200. A Fender FA-135CE acoustic/electric guitar, clearly a brand name guitar which received four and a half stars in reviews, is available as this is being written for $169 including shipping and six month same as cash financing is available from a large online dealer (Fender FA-135CE, 2019). If a straight electric guitar is the choice, a Fender Squier Affinity Stratocaster, the entry-level version of one of the most iconic electric guitars in the world, can be purchased for under $200 (Squier by Fender Affinity Series Stratocaster, 2019). For those in a tighter budget, Fender offers the Quit Dreaming and Start Playing kit including a Squier Stratocaster (a lower priced version), Fender 10 watt amp, tuner, picks, strap, and a lesson CD for $219.99 (Squier by Fender Shortscale…, 2019).

As this hypothetical guitarist improves and wants to expand his skill set, though, the miracle of MIDI offers some truly impressive bargains. Consider, for example, the Peavey Vypyr® series of modeling amplifiers. The "modeling" in the term modeling amp means that the amplifier can emulate the unique sounds of other amps. The entry level Peavey Vypyr®, the VIP 1, retails at $149.99 (Peavey Vypyr® VIP 1 Guitar Modeling Amp, 2019). Consider what MIDI has made possible in this affordable package. Straight out of the box our student has 12 amp models available including specifically for acoustic guitars, for bass guitars, and for electric guitars. There are 22 effects, pedals, available, and when one considers that individual pedals run an average of $50 each this represents over $1,000 in expenses our student avoids. Add a Peavey Sanpera 1 foot controller for $124.99 (Peavey Sanpera 1, 2019) or Peavey Sanpera 2 for $224.99 (Peavey Electronics Sanpera II, 2019) and our hypothetical beginner guitarist is still under $600 for a musical capability that early rock and roll groups like Bill Haley and the Comets would not have been able to put together for any price because the technology simply did not exist yet. An on-board looper capability, once that first Sanpera is purchased, makes multitrack recording available without any additional equipment involved. Add in a $359.99 laptop computer (Asus 15.6" Laptop…, 2019), and a freely available MIDI editor (Schwenk, Markus, n.d.) and our guitar student has a pretty impressive recording studio. He will, in other words, have replaced that traditional "one man band" - -

Fig. 3 Peavey Vypr® VIP1 Amp Faceplate (Source: Carter, 2018)

Besides keyboards emulating the traditional piano and organ, other instruments have been produced to generate a MIDI signal. There are woodwinds, brass instruments, string instruments, and drums. In other words, there are MIDI instruments for essentially every instrument in an orchestra. Additionally, all of these and many others are available in a downloadable format, generally referred to as jamtracks. A simple google search for "free MIDI jamtracks" yields over 38,000 returns (Free MIDI jamtracks, 2019). These professional tracks, available for IoS (IPhones), Android (Android based devices), or for PCs and Macs allow our amateur to practice with any new instruments with backgrounds provided by professional musicians.

2.3 The Core of MIDIs Longevity and Popularity is Its Ease of Use

Returning to that Peavey Vypyr® mentioned above, let us review how it works. The amp itself has a faceplate that can seem intimidating. When connected by a simple MIDI to USB cable to a $200 laptop, though, the difficulties disappear. The opening screen asks which MIDI system will be used. Even first
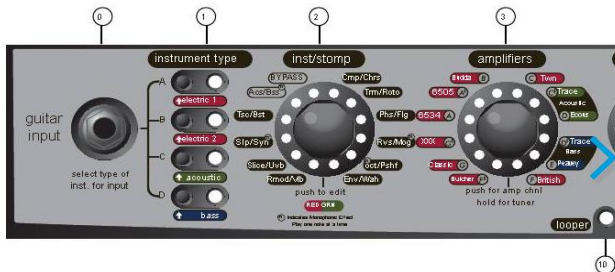

Fig. 4. Peavey Vypyr® Editing Software Effects Selection Screen.

Editing Software 1.0. (2013). Source: Peavey -time users have the system available though, through the software provided as part of the amp purchase. Simply select the VYPYR USB Interface option for both the MIDI in Port and MIDI out Port and proceed. Next, simply uncheck the "demo" feature and the options selected will be played through the built-in speaker of the amp. First, the amp to be emulated can be selected from the 12 available.
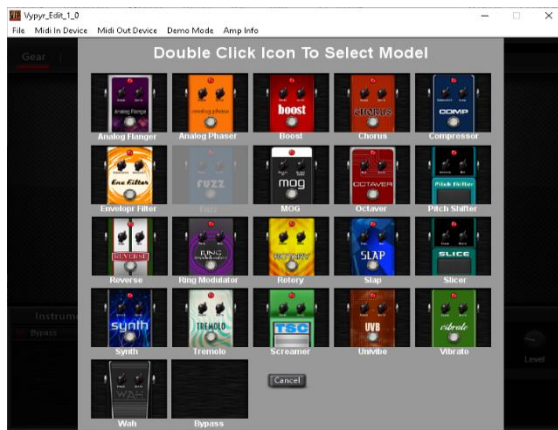
Fig. 5. Peavey Vypyr® VIP 1 Guitar Modeling Amp Operating Manual. (2019)

The basic settings available directly from the amplifier, the amount of reverb, delay, pre and post gain can be set, and the user can experiment, hearing precisely what these settings do. Next, any of the 22 effects options, the pedals or "stompboxes" can be selected, adjusted, and played. Once the user is satisfied, he can assign it to one of the presets on the amplifier and that combination of amplifier/effects will be available in the onboard memory of the amp, even if the computer is no longer connected.
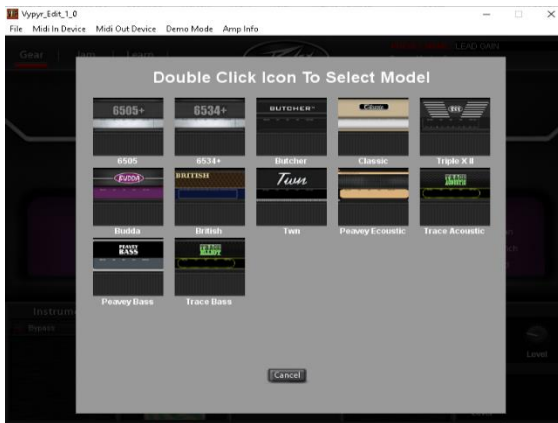

Fig. 6 Peavey Vypyr® Editing Software Amp Selection Screen Source: Peavey Electronics Vypyr® Editing Software 1.0. (2013).

For example, our hypothetical guitar student might be wanting to play the lead melody from the jazz standard *Harlem Nocturne*. Since this was originally written as a saxophone solo, a bright amplifier with a lot of treble boost would be a good choice. Then a tremolo effect to mimic the original recording could be added directly from the computer. Alternatively, the student might want to ignore previous versions and experiment with his own interpretation of the classic. He can do so directly from the keyboard and when satisfied, load the various selections he used to achieve his sound onto the amp. This simplicity of use is a hallmark of the MIDI system and the key to its longevity.

2.4 The potential for Production

To this point we have been discussing the impact of MIDI on an amateur's growth as a guitarist. That impact, prodigious as it is, pales in comparison to the potential for a full-blown home recording studio. Interest has grown to the point that the seven basic components of a home studio capable of professional results (Home Recording Studio Setup For Beginners, 2019) are available from that source of all everything, Amazon, in an inexpensive kit. For $349.99, for example, the amateur music producer can get:

1. An iRig Pro Duo 2-channel recording interface compatible with Mac, PC, IoS, and Android;

2. An iRig keys Pro 37-note MIDI controller for those platforms;

3. An iRig professional quality microphone;

4. An iRig set of professional quality headphones; and,

5. The associated cables and stands to set up your studio (IK Multimedia iRig Pro… (2019).

Such kits are available from a variety of manufacturers and a variety of prices. Individual components can increase the price and the quality of the final production. High end keyboards or microphones can make a real difference. For most instruments however, the artist will have already made his choice and simply need a MIDI converter to handle his playing.

3. THE FUTURE OF MIDI

That great American philosopher Yogi Berra, among many others, famously observed, prediction is hard, especially when it's about the future. Nevertheless, there are some predictions regarding the future of MIDI that seem safe. In part it is an issue of MIDI itself. In part, it is a question of the uses to which MIDI will be put.

While MIDI is a standardization, a language, that contains very specific rules, there are still areas for further standardization. The continuous controller (CC) functions, for example, are numbered 0 - 127, allowing 128 separate commands. For example, CC-0 is the bank select message, CC-36 is a foot pedal select message, CC-42 is the pan position message, and so on (MIDI Basics: Common Terms Explained, n.d.). Many CC values are left undefined, though, allowing flexibility. This has proven to be a successful enough system, with enough flexibility, to have survived over three decades as the standard for digital music production. A revision is underway, MIDI Capability Inquiries (MIDI-CI). This revision has been incorporated into the recently announced release of MIDI 2.0. The MIDI Manufacturing Association and the Association of Music Electronics Industry, the Japanese association of MIDI manufacturers, announced that a formal updating of the three and a half decade old system, truly ancient in the world of software development, would be undertaken in 2019 (MIDI 2.0 Prototyping Announced, 2019: see also Fortner, 2018).

For the foreseeable future then, there is no doubt that amateur music production will continue to become more and more common. With modern cellphones gaining in computing power and capabilities, the common example being that today's cellphones have magnitudes more power than was available to put a man on the moon (Puiu, 2015), and as apps are developed to support MIDI on cellphones, more portability will be available. Given the sheer physical difficulty of using the keyboard on a cellphone, though, most of the final composition will be done on laptops or PC towers.

We have already seen the selection of instruments available in the MIDI format. More and more will, without doubt, be added. A variety of percussion, brass, woodwinds, and strings are already out there, many at no charge. More background tracks as well as individual instruments will be published as time passes. A young guitarist wanting to learn his licks from Eric Clapton or B.B. King will have a backing track indistinguishable from the original with which to practice.

Equally certain is that manufacturers will continue to develop new equipment. This will not only reproduce music with a level of fidelity always improving but will allow for more control over the tones and sounds

produced. Already equipment exists to allow a single singer to record harmony in several voicings. An entire orchestra can be produced by a single laptop, or even a cellphone.

Audiophile purists may believe that vinyl recordings remain the better medium for music recording and playback. The primary argument on the side of vinyl is that the analogue systems provide a "warmer" sound (Dankosky, 2012). Some also equate the physical activity of laying the traditional vinyl record on the turntable and setting the stylus at the proper location as part of the overall listening experience.

To the sound engineer, however, this is nonsense. The sound may, indeed, be "warmer," but that is a function of the analog systems putting their own stamp on it (Ibid.) The digital signal, based on extremely fast sample rates, approaching 200,000 discrete units per second (McKelhearn, 2011) and the MIDI system of compatibility, is producing the most accurate possible reproduction of the music that is being recorded. With improved hardware and ever improving software, the accuracy of reproduction will only get better. For those audiophiles who miss the warmth of classic analog vinyl recordings, analog/vinyl emulators are already available in a MIDI format and doubtless more will be developed.

CONCLUSION

In summary then, we have seen six waves of music. The first wave was the most basic music possible, percussion to hold the beat of religious or quasi-religious ceremonies. The second wave, coincidental with the Neolithic revolution and the gathering of human beings into large, permanent communities, took music to instruments that produced tones as well as a simple percussion beat. The precursors of all of today's instruments were seen including brass and woodwind horns, stringed instruments including fretted guitars and the first of the unfretted violin family, and the first recorded music in the form of cuneiform tablets containing the words to apparently religious songs. The third wave could be legitimately called the Greek wave. The Greco-Roman culture established many of the characteristics seen in music today, most obviously the division of scales into octaves and establishing the relationship of chords and scales. The fourth wave is, in many ways, the classical music wave. The music of the renaissance through the 19th century embraces the range from the complexities of the baroque era to the gentleness of the romantics and produced the names that ring down through the history of music. Beethoven, Bach, Mozart, Liszt, Brahms, Handel, Tchaikovsky, and so many others from that wave are still played today. The perfection of musical notation combined with the invention of the printing press meant that it was the fourth wave that made identical compositions available throughout the world. The fifth wave is the wave of recorded music. From Edison's first tinfoil cylinders through a room filling stereo system available in 2019 for under $500, recorded music truly brought music to the masses, especially when recorded music was combined with radio.

The sixth wave is the MIDI wave. This latest music production and reproduction system has made an impact on music in two separate and important ways. It has become a component of musicians producing their sound. The Peavey Vypyr® modeling amps mentioned earlier, for example, rely on MIDI codes to emulate the effects of the various pedals and amplifiers that makes them such a powerful tool. Keyboards use MIDI codes to emulate various instruments. The MIDI system, with the potential for extremely fast sampling rates, can produce sounds indistinguishable from the original instruments that were recorded.

In its second effect, the standardization inherent in the MIDI system supports relatively inexpensive home recording studios that are the equivalent of the capabilities of even the most well-equipped commercial studios of a few decades ago. The home computer, a laptop, or even a cell phone provides a level of control that only the most complex mixing boards could manage before. The classic garage band can now be recorded to a level that Buddy Holly or Ritchie Valens never had available.

The clear conclusion is that MIDI is here to stay. The improvements being offered with the MIDI-CI and its offspring MIDI 2.0 are very evolutionary. Possibly more important, every new iteration of the MIDI system is set up to be backward compatible. The design of the later versions often imparts the new features to the older version seamlessly. MIDI has been the standard for digitized music reproduction and production since 1983 and is only now undergoing its first revision qualifying as a MIDI 2.0 update. Longevity like that is almost unheard of in the rapidly changing digital world. Consider that Microsoft Windows was essentially contemporary with MIDI, with the original Windows released in 1985. In 2019, as work is progressing on MIDI 2.0, Windows 10 is receiving major upgrades twice a year and as support for previous versions, Windows 7 and Windows 8, are dropped Windows 10 will be redesignated simply as Windows with a subscription based update service to keep it current (Schofield, 2019). MIDI, on the other hand, as a single purpose system dedicated to music, has been almost eternal and promises to continue to be.

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