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Citation for published version:

Williams, S 2012, Tubby's dub style: The live art of record production. in *The Art of Record Production: An Introductory Reader for a New Academic Field*. Ashgate popular and folk music series, Ashgate Publishing, pp. 235-246.

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

The Art of Record Production

Publisher Rights Statement:

© Williams, S. (2012). Tubby's dub style: The live art of record production. In *The Art of Record Production: An Introductory Reader for a New Academic Field*. (pp. 235-246). (Ashgate popular and folk music series). Ashgate.

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CHAPTER FIFTEEN

Tubby's Dub Style: The Live Art Of Record Production

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Abstract

This paper is a material analysis of the tools and techniques used by King Tubby and his apprentices at his 18 Dromilly Avenue Studio in the key period from 1972 when the dub style developed until the late 1970s. Concentrating on the individual tools used for delay, reverberation and filtering, the routing and signal path of the studio as a whole is traced and explained with a view to developing an understanding of Tubby's individual style and its relationship with the limitations and specific characteristics of the technology used. Central to this analysis is an examination of the MCI mixing desk which is the subject of much myth-making.

I conclude that whilst a material study can illuminate the reasons behind some choices and effects, the overriding defining force behind Tubby's dub style is not the use of particular instruments or 'secret weapons' but is an alignment between knowledge and technology within the context of the environment in which the music was made.

Methodology

In this chapter I use several different approaches including interviews, analysis of video footage, and transcription of audio recordings, but the primary focus of my research has been a material analysis of the technology used by King Tubby to produce records from

1972 to 1979 at 18 Dromilly Avenue, Kingston Jamaica. Since King Tubby's studio no longer exists in the form it took in the 1970s some of the technical details remain speculative. However, the MCI mixing desk, the centre-piece of his studio, currently resides in the collection of the Experience Music Project, Seattle, and I have been able to examine it in its current condition. In the absence of written records or film footage of King Tubby's own studio practice, I have used footage of one of his apprentices, Lloyd "Prince Jammy" James, to work out some details of signal routing and performance practice within the Dromilly Avenue studio, but given the highly reflexive nature of this studio practice and the inevitable presence of feedback systems (both figurative and literal in the case of tape delay) some of the most valuable insights have come from recreations of the studio setup that I have made and incorporated into my own creative music practice.

Whilst the emphasis of this paper is on technical detail, it is essential that this research be considered within the wider ecological perspective as suggested by Bateson, and elaborated upon by Waters through the idea of the 'performance ecosystem'¹. The feedback paths between use of particular tools and techniques, the personnel in the studio during the mix, the testing of the dub-plates on the sound-system at the dance, the queue of producers outside the studio waiting to have their recordings mixed, all exert influence on the way the music on the record sounds. Far from taking a technologically deterministic position, I believe that a close examination of the tools and techniques from a material perspective can provide useful information about how affordances were exploited, how limitations were overcome, and essentially how an alignment of Tubby's knowledge and expertise with the technology at his disposal not

¹ Waters, S. 'Performance Ecosystems: Ecological approaches to musical interaction.' *Electroacoustic Music Studies Network*. (2007)

only shaped his own music but also influenced the many different genres and styles of recorded music making across the world. This reflexive practice cannot be abstracted from the social and cultural environment within which it operated, and this paper therefore presents an analysis of the technological perspective in acknowledgment that this is only one part of a much more complicated story.

Introduction

Osbourne Ruddock (1941-1989), otherwise known as King Tubby, is widely credited as being one of the most influential figures in the development of the style of music originating in Kingston Jamaica in the early 1970s known as Dub. Common recording practice in Kingston in the late 1960s and early 1970s was to record the backing track consisting of drums, bass, rhythm (guitar and organ) and horns onto four-track tape, and then to record the vocals at a separate "voicing" session, often in another studio. This allowed producers to use the same backing track or "rhythm" for several different singers and even to use different lyrics, and to mix the backing tracks accordingly. Another common format was to record drums, bass, rhythm (with horns on the same track), and vocals onto a four-track tape ready for mixing directly onto a mono or stereo master. King Tubby's small studio in the bedroom of the house at 18 Dromilly Avenue in the Waterhouse district of Kingston Jamaica was equipped only to mix these four-track tapes and occasionally to record vocalists (in the old bathroom) on top of these existing rhythms in voicing sessions. Except for one isolated report of Lee "Scratch" Perry attempting to record drums in the tiny bathroom vocal-booth with a bass player sitting in the control room², it was not equipped for full recording sessions. Whilst it is

² Veal, M. E. *Soundscapes and shattered songs in Jamaican reggae*. (Middletown, CT, Wesleyan University Press. 2007), p. 148

commonly accepted that the distinctive sound of records produced at studios such as Sun Studios, Abbey Road Studio 2, or Goldstar (Phil Spector's Wall of Sound) is the result of the specific combination of the acoustic recording space, the technology, the engineering skills, and quite often, the regular session musicians used, with Tubby's dub mixes we can eliminate the acoustic element and the musicians' influence as being anything more than generalized since he was mixing tapes originally recorded at many different studios by many different players. The two remaining constant elements therefore, that contribute to the distinctive sonic characteristics - the soundprint - of mixes made at Tubby's studio are the equipment used and the performance practice associated with the act of *mixing* as opposed to the original act of recording. It is worth noting that these elements are electrical and physical as opposed to being acoustic and physical, and therefore it is useful to think of King Tubby as an electronic music maker. Except for the occasional aforementioned voicing sessions, the only performers recorded at Tubby's studio were the engineers performing the mixes: King Tubby and his apprentices; Philip Smart, Lloyd "Prince Jammy" James, Pat Kelly and Overton "Scientist" Brown amongst others. Given the amount of transformation and reinterpretation that happens in Tubby's mixes and the dissimilarity between the song as recorded initially and Tubby's substantially altered mix of the song, the mixing desk and the associated effects devices and machinery must be thought of as Tubby's musical instrument, and defining this instrument and working out how it was played can provide a useful perspective for a critical analysis of King Tubby's dub style.

Tubby was originally an electrical engineer and crucially, in the mid 1960s, built and ran the celebrated *Tubby's Home Town Hi-Fi* sound system. Sound systems featuring DJs playing records as opposed to performances from live bands have been

central to Jamaican dance music culture since the 1950s³, providing a nucleus for the outdoor dances and often being run as extensions to record businesses such as those operated by Duke Reid and Clement "Coxone" Dodd. Tubby was an early adopter of transistor technology, using transistor amplifiers for the treble speakers, and valve amplifiers for the bass. He used steel horns for the treble speakers, suspending them from trees where possible, so as to project the high frequencies evenly across the dancefloor.⁴ This level of care and attention to sound quality won him many clients ordering amplifiers for their own sound systems, and Tubby's later incorporation of tape delay (and probably reverb) in his sound system controls for live spatial effects, increased the flow of orders. In order to make suitable crossovers and the very large transformers needed for his sound system, he had to wind his own, and this was a regular duty of his various apprentices including Lloyd "Prince Jammy" James, Overton "Scientist" Brown, and Philip Smart.

Although *King Tubby's Home Town Hi-Fi* wasn't the largest sound system in Jamaica it was widely acknowledged as being the best sounding⁵. His intimate understanding of frequency ranges, filtering, and speaker response needed for designing and constructing sound systems for himself and his many customers, coupled with his attention to detail contributed to his extensive skills at cutting records as a mastering engineer. Bradley relates how other sound system operators such as Duke Reid and Coxson Dodd would sometimes audition their dub-plates on Tubby's sound system rather than their own in order to hear them properly. This fastidiousness is indicative of

³ Bradley, L. *Bass culture: when reggae was king*. (London, Viking. 2000)

⁴ Ibid, p. 314

⁵ Bradley, L. *Bass culture: when reggae was king*. (London, Viking. 2000), and Veal, M. E. *Soundscapes and shattered songs in Jamaican reggae*. (Middletown, CT, Wesleyan University Press. 2007), pp. 314-

the care taken in his practice both as a mastering engineer and as a creative 'dub organizer'⁶.

Recording the rhythms separately to the vocals allowed producers to release different versions of the same song, but Tubby was able to take this same rhythm and with or without using the vocal track, was able to make a mix that was so substantially different to the original that it could be released as the b-side of the single, thereby removing the necessity for the producer to pay for recording a different track for that purpose. Not just an economic way to fill a b-side, if this dub mix was good enough it would become more popular than the a-side, and this soon led to the release of entire dub albums such as Lee Perry's *14 Dub Blackboard Jungle* (Upsetters, 1973) and Augustus Pablo's *King Tubbys Meets Rockers Uptown* (Yard Music, 1976), both of which heavily featured King Tubby's mixing skills. Once he started remixing - making dub versions - he was able to start making much more creative, performative decisions in the studio, and, once cut to a dub-plate, these versions could be played to, and tested on an audience using his own sound system within a matter of hours, allowing almost instant feedback and fine tuning of his mixes. Running the sound system was therefore a key factor in the evolution of his mixing style. Tubby's studio remained in high demand through the 1970s with Tubby eventually taking a back seat to focus more on the sound system part of the business, leaving the bulk of the mixing work to his apprentices. The popularity of dub reached a low point in the early 1980s and eventually the MCI mixing desk was replaced and, after being in the possession of Rodwell "Blackbeard" Sinclair for some years, was purchased in January 2001 by the Experience Music Project in Seattle. King Tubby was murdered outside his home in February 1989.

⁶ "Dub Organizer" is the title of a record produced by Lee "Scratch" Perry, voiced (by Dillinger) and mixed at Tubby's studio containing the line: "Tubby's are the dub organizer".

Instruments

There are an astonishing number of stories and myths surrounding Tubby's equipment and unpicking these has been difficult. Putting together information from accounts by Bradley and Veal, various interviews with assistants, sleeve notes and other less formal sources, it appears that he was indeed using a homemade mixer, with no real multi-track capabilities, until the 1972 purchase, facilitated by Bunny Lee, of the old MCI mixing desk and Scully and Ampex 4-track tape machines from Byron Lee's Dynamic Sounds studios, formerly West Indies Recording Label (WIRL). This mixing desk was designed and built by Grover C. "Jeep" Harned of Music Centre Incorporated (MCI) in the mid-to-late 1960s. At this time mixing desks were not available as off-the-shelf items and they were either produced in very small runs or were more often custom made and tailored to the requirements of individual recording studios. Makers would use a combination of self-designed and borrowed circuitry and would use stock items for the more mechanical elements such as VU meters and faders. MCI started making one of the first widely available production models known as the JH400 series in 1973, but before this, each desk would have been almost unique. Because all the signals were routed through it and it occupied the central focus of the studio, this MCI desk is the most important tool and arguably had the biggest impact on Tubby's new sound and dub style. The desk, commonly and misleadingly referred to as a four-track mixer, has twelve input channels, each with gain, basic equalization (EQ), one auxiliary send and a channel fader. Four output buses are controlled by four Painton-style quadrant faders⁷, there is a test-tone oscillator, monitor controls, a very early example of remote tape

⁷ Found on many BBC, EMI and other mixing desks from the mid to late 20th Century, these faders describe part of a circle rather than being linear tracking and work by means of stud contacts switching discreet resistors into the signal path rather than by the continuous conductive plastic or carbon tracks used in later designs. Harned's famous desk made for Criteria Studios in Miami exhibits quadrant faders on each channel.

transport control, and a patchable high-pass filter. The patchbay built into the side of the desk allows access to the signal path at various points in the signal chain for each channel and bus as well as access to the high-pass filter. The main sound-transforming tools used by King Tubby are the high-pass filter, volume controls, reverberation and delay.

King Tubby's "Big Knob" Filter

Tubby's so-called "Big Knob" filter has eleven frequency steps from 70Hz to 7.5KHz⁸ all accessible within 165 degrees of rotation, allowing extreme sweeps to be performed with ease. It is situated at the top right hand corner of the master section and is operated by means of a 40mm diameter control knob. The knobs for controlling almost all the other features such as EQ settings, auxiliary sends etc. are a smaller 30mm, hence the name. High-pass filters are usually used to mitigate against proximity effect or to reduce low-frequency rumble, so the rationale behind the enormous frequency range exhibited here is initially unclear. On examining the desk at the Experience Music Project in Seattle, I discovered that the filter is a standard production model filter module made, like other components in the desk, by Altec, and not individually designed by Jeep Harned at all. This fits with Bob Ohlsson's comments about Harned building a small number of custom desks from Altec and Langevin parts prior to launching the MCI 400 series desks⁹.

The hand of Art Davis hovers over the shared designs of many EQs and filters of this period by Altec, Langevin and Cinema Engineering and during the 1960s there were all sorts of arrangements, takeovers and relationships between these companies as

⁸ 70Hz, 100Hz, 150Hz, 250Hz, 500Hz, 1kHz, 2kHz, 3kHz, 5kHz, 7.5kHz.

⁹ Ohlsson, B. *Mid 60's custom MCI consoles*. Retrieved 14/02/11, 2011, from <http://recforums.prosoundweb.com/index.php/m/113753/0/> (2004)

well as Electrodyne. This particular filter, an Altec 9069b, is a passive inductor based T-network filter, in the same family as the Langevin EQ255a (with which it shares identical frequency step values), and the Cinema Engineering 4031, and in the same class as the Urei 565 "Little Dipper", the Eckmiller HV-55, the Maihak W49 HörspielVerzerrer (radio play distorter) and other units by Danish firm NTP, Neumann, Siemens and the other German Broadcast companies. These devices comprise the class of *radiophonic* or *sound effects filters* typically used to simulate distant sound or spatial dislocation, voice mediated through radio or telephone, and other such spatial effects in radio and cinema sound design. The main characteristic of these filters, whether they are passive or active, is that they have stepped frequency selection. This precludes their use as dynamic performance instruments from a design point of view - indeed, the Maihak W49 has printed on it right above the frequency selectors 'Nür gerastete Stellungen benützen' [*only use detented settings*] - so it took a leap of imagination by people such as King Tubby and Karlheinz Stockhausen¹⁰ to use such filters in this way. This perhaps explains why nobody at Dynamic Sounds made much use of the filter while the desk was there, and further supports the case against technological determinism. The stepped nature aligns it with a set-and-forget practice associated with traditional utility high-pass filters as usually found on input channels of mixing desks and microphone pre-amps.

His apprentices spent time winding transformers (and presumably inductors too) for the many sound system clients¹¹, so Tubby's familiarity with crossovers and filters as part of his sound system work make it unsurprising that he began to experiment with this filter creatively very soon after acquiring the desk. Indeed, there are accounts of

¹⁰ Stockhausen made extensive use of the W49 in both composition and performance. For a comparative study of Stockhausen and King Tubby's use of stepped filters see *Stockhausen meets King Tubby's: the stepped filter and its influence as a musical instrument on two different styles of music*. (Williams 2011)

¹¹ Veal, M. E. *Soundscapes*, p. 132

him using crossover networks with his previous homemade mixing desk to split a monophonic signal (from a record or tape) into different frequency bands, allowing him to remix a mono recording by being able to attenuate the bass, mid-range and treble independently, much like using kill-switches on some contemporary DJ mixers.

Prince Jammy recounts some details about the MCI mixer:

It was a very unique board because it was custom built for Dynamic Sounds ... it had things that the modern boards nowadays don't really have, like a high-pass filter that made some squawky sounds when you change the frequency... We would put any instrument through it – drums, bass, riddim, voices. That high-pass filter is what create (sic) the unique sound at Tubby's.¹²

Chris Lane refers to the filter as Tubby's 'secret weapon'¹³, but acknowledges that it is but one of many techniques that form Tubby's style. The strongest characteristics of the filter's sound are the discreet steps, the clicks and crunches when the frequency is switched, and the phasing effect heard when filtered signals are mixed with the unfiltered originals. The most reasonable assumption is that signals were routed to the filter via one of the four output groups which is corroborated by this account from Bunny Lee:

an' Tubby's studio did 'ave a ting weh you could a thin it, an' do all different kinda ting with it, right, - it's not even really equalization, the ting 'ave four push-up ting, when you push the one in the middle and 'ave it up and down, with the ting, it create some mad sound, like you hear all some knife a cut thru'.¹⁴

The 'ting [...] in the middle' refers to one of the four bus faders and supports the idea that it was used as the filter send. Sending the whole mix through the high-pass filter would not result in audible phasing of the signal, but by sending the signal via a

¹² Ibid, p. 114

¹³ Lane, C. *A Musical Revolution*. In *Natty Dread: Le Magazine du Reggae*. Issue 19. (Natty Dread. France. 2003)

¹⁴ Ruddock, O. *Dub Gone Crazy*. (Manchester, Blood And Fire Ltd. 1994) Sleeve notes.

but it would be possible to mix the filtered sound with the dry sound and this would make the phase differences around the cut-off frequency audible. This effect explains the occasional references to Tubby using a phaser.

In the context of a mono mix the high-pass filter is an extremely useful spatialization tool in a different way than delay or reverb. Being familiar with the crossover frequencies for his sound system amplifiers, Tubby would have been keenly aware of what filter settings to use to separate some sounds so that they were only projected through the suspended horns. Manipulating the filter control would then physically move the sound vertically through the dancefloor, and adding reverb and delay would create an enormous range of spatio-temporal effects.

Faders

Another key performance detail is the shape of the fader caps. They are the round 'Rolo' style, much used by Langevin and Altec, which make for a more tactile control over the volume, and in the absence of mute switches the feel of the faders would have been all the more important since they were used heavily throughout a mix, and often moved very quickly with precise timing to immediately cut or reintroduce a sound. It is hard to quantify the contribution of the fader design to Tubby's mixing style, but, as the key interface between the musician and the music, this must be taken into account, as should the linear scale of the fader, marked in regularly spaced 5dB units, thus differing from contemporary faders which exhibit a more sensitive area around 0dB as well the ability to increase gain typically by 10dB. A qualitative analysis must be approached by acquiring some original Langevin faders and incorporating them into a performance practice but at this point I am yet to locate any with which to experiment.

There are many stories of Tubby replacing the faders on his mixing desk, but I found no clear evidence of any customization unless the entire top panel has been replaced and re-engraved, which is highly unlikely. All the visible controls match the legend exactly and the only evidence that I could find in support of the idea that the faders could have been replaced was a slight variation in the shape of the two bolt-heads used to secure each channel fader to the fascia. All the other bolts are countersunk flat-headed bolts, but these are slightly round headed.

However, the fader caps are the red 'Rolo' shaped Langevin/Altec style, consistent with the fader modules themselves, and the legend stamped into the one-piece surface of the desk matches the scale of the fascia supplied with the Langevin faders available at the time. Even the layout of the fader module and EQ module for each channel mirrors the layout of the closely related Electrodyne channel strips of the 1960s and the whole channel layout is remarkably similar to the Electrodyne ACC-1204 console, so if Tubby did replace the faders they were either a like-for-like replacement, or he was very lucky to find a different variety that fitted exactly. It is conceivable that he could have replaced older stepped attenuators/faders with continuous faders from the same manufacturer. Either way, they are clearly consistent with the desk being built by Harned from parts manufactured either by Altec, Langevin, or Electrodyne, and there is no evidence at all for Tubby having replaced rotary potentiometers with linear faders on this desk. The fader stories may well relate to modifications carried out on his previous homemade mixer but that is beyond the scope of this paper to ascertain. The quadrant faders on the buses are similar to those used on Harned's MCI desk built slightly earlier for Criteria Studios in Florida and a similar desk built for King Studios. The coloured caps, red, blue, green, and white, correspond to the coloured legend indicating the bus

output connectors at the rear of the desk, so it is unlikely that these have ever been replaced either with anything but like-for-like substitutes.

Reverberation

The other main elements in the mix are reverberation (reverb) and delay. Reverb was routed via the single auxiliary send, accessed for each channel by a rotary control immediately above each channel fader, to a Fisher K-10 SpaceXpander - an American valve driven spring reverberation unit designed for the domestic hi-fi market to 'simulate the echoes of a well-designed auditorium'¹⁵. Several accounts report that this unit was heavily modified by Tubby, but experimentation has so far only revealed that muting one of the two springs in the reverb tank produces a sound closer to that heard on the records. The inputs and outputs on a Fisher K-10 are unbalanced RCA/phono sockets, and on inspecting the desk I found two cables with RCA/phono plugs hanging out of the back with the other ends hard wired into the inside of the desk. Since the tape machines and the other outboard equipment would have been connected via XLR or ¼" jack connectors, this increases the probability that these RCA/phono plugs might have been used for connecting the K-10. This would suggest at least some level of modification to the send source or return destination of the reverb signal within the desk, but exactly what remains a mystery. Many of Tubby's records feature the spring tank being dropped or knocked, and this is such a harsh sound in relation to the normal reverb levels that it strongly suggests the use of compression, probably on the main output of the mixer. Tubby's dub of John Holt's 'A Quiet Place', entitled 'A Noisy Place' featured on *King Tubby's In Fine Style* is a classic example of this often used trick. Since compression is a standard tool used for mastering and mixing, it would be highly

¹⁵ Fisher, A. *The Fisher K-10 Dynamic SpaceXpander Reverberation Unit. Operating Instructions and Warranty*. (USA, Fisher Radio Corporation. 1967), p. 14

unusual for Tubby's studio not to have the option of using compression on individual tracks or the across the whole mix.

Delay

Given that there were two four-track tape machines in the studio, I have asked several experienced engineers and technicians including Graham Hinton (EMS, SSL Amek) and Steve Albini (Electrical Audio) which they would have used for playback and which for delay, and the universal answer has been to use the Ampex for playback and the Scully for delay. Chris Lane's recollections of the studio support this assumption, so I believe that delay was achieved using the Scully 4-track, but in the absence of a second auxiliary send, each channel was routed to an additional output bus, which fed the tape-delay input post-channel-fader. In such a setup, the signal is recorded onto the tape with the record head and immediately played back via the playback head with the delay time being the distance between the record and playback heads divided by the tape speed. With one bus used for the main mix and one used for the filter, this left two possible buses for delay, and in the video clip of Prince Jammy performing two dub mixes in Tubby's studio from the film *Deep Roots Music* (Johnson and Pines 1982), you can see Jammy (who is not using the high-pass filter and therefore has three available delay send buses) using three channels for drum delay and voice and guitar delay respectively. The tape outputs were returned on their own channels and these channels were also routed back to the respective tape delay output-bus as well as to the master output, thus enabling both delay level and feedback to be controlled for each delay channel by that channel fader alone. In the absence of the limitation of only one auxiliary send it is usual to have two separate controls for delay feedback and delay level. Having incorporated Tubby's limitation of one control for both parameters into

my own practice for some live performances, I found it to be extremely effective because it freed up one hand which could then control other parameters.

Chris Lane recounted to me of his visit in 1977 that whilst he and Dave Hendley were having some tracks mixed by Prince Jammy, they asked him to make a faster delay by switching playback speed of the delay machine from 7.5 ips to 15 ips thereby halving the delay time. Lane relates that Jammy 'wasn't best pleased about this 17 year old kid interfering with his mixing style' (interview with the author 2009) but that they had not used the faster tape speed before and would try it and see if it sounded good. Lane told me how he heard the faster delay used on a few records after that visit but it doesn't appear to have been used much. It is, however, used to striking effect on 'Tubby's Dub Song' from Dave Hendley's *King Tubby's In Fine Style* compilation. It might have been possible to vari-speed the Scully machine but I have not noticed this effect in any output from Tubby's studio yet. The significance of this fixed delay time is that it influences interpretation and criticism of the rhythmic qualities arising from the use of delay in some tunes. Veal attributes the double-speed drum track in Yabby You's 'Fire Fire Dub' to a conscious decision¹⁶, but given the technical limitations of just two different delay-times, perhaps this effect is achieved less by design more by serendipity with the delay time accidentally being in sync with the track tempo. Either way, it still relies on Tubby's musical sense to make the decision about whether to use it in this context or not, and being able to recognize and make creative use of such an effect is a familiar technique relied upon by improvising musicians in all genres.

It is clear that although limited in features, the equipment Tubby was using was generally of very high quality indeed.

¹⁶ Veal, M. E. *Soundscapes*, pp. 121-2

Performance Practice

The wear patterns on the desk, coupled with the footage of Prince Jammy at the controls suggest that inputs from the four-track tape were on channels 7 to 10, and delay returns were on channels 1 and 2 and possibly 3, with filter return possibly on channel 11 or 12. Such an arrangement allows for a central mixing position with the four main channels accessible by both hands, delay channels operated by the left hand, and filtering by the right, with both hands able to access the reverb sends. What is striking about the footage of Jammy is the economy of movement and the agility with which the controls are manipulated. This is something more than an engineer carrying out a technical exercise at a mixing desk - it is clearly a highly skilled musician performing with a musical instrument. The limitation of only four tape channels is a liberating constraint that allowed more focus on the effects manipulation, more careful performance on the channel volume faders, and greater flexibility for one performer to structure the mix as a whole.

Sixteen-track and later, twentyfour-track recording, which became the standard in most professional studios in the 1970s, would easily confront the performer with a paralysis of choice and it is perhaps no accident that the increased number of tracks adopted in later years coincided with a change of quality in dub production, not necessarily for the better. The MCI mixing desk is only 90cm wide which allows the engineer to reach all controls easily without moving around. Not only is there a danger of paralysis of choice when working on a larger mixing desk, but the extreme width of many large format SSL desks with forty eight-plus channels and their unhelpful ergonomics make the act of mixing far less intuitive and physically more demanding;

parallax error in channel selection and different parameters being too far apart are two obvious problems of larger consoles not exhibited by the MCI desk.

For me, the most exciting physical evidence of performance practice are the aforementioned wear patterns on the surface of the desk, particularly around the filter control, with clearly visible traces of thumb, fingers and the palm of the right hand indicating heavy usage. It brings to mind the Fender signature series of guitars such as, Andy Summers' Telecaster and Jaco Pastorius' Jazz Bass and, in the absence of any film footage of Tubby himself, provides the clearest visible evidence of Tubby's performance practice.

Tubby's feel is sometimes ascribed to his love of jazz¹⁷, and the improvisatory nature of his mixes supports this theory. To quote Bunny Lee: 'if he mix the same tune a dozen times you will have twelve different version.'¹⁸ Tubby fixes his improvisations in the form of records, and he draws on a number of structural, spatial, rhythmic, and timbral techniques to stamp his identity onto each version. In 'Rebel Dance' at around bar 33, he uses the clicks and crunches as the filter is switched between frequency steps to punctuate and augment the rhythm with a triplet feel. This would not be possible with a continuously variable synthesizer filter but it is also clear that it is not simply technological determinism at work here either. To use Stephen Hill's expression, it is the *alignment*¹⁹ of Tubby's tacit knowledge of electronics coupled with his musicality and the affordance of the instrument characterized by the clicks and steps, which combine in his practice and which make it unique and which allows him to make

¹⁷ Veal, M. E. *Soundscapes*, p. 117

¹⁸ Bradley *Bass culture*, p. 316

¹⁹ Hill, S. *The tragedy of technology : human liberation versus domination in the late twentieth century*. (London, Pluto. 1988)

significant musical changes to a tune's internal rhythm. An argument can be made that tape delay is also used to re-structure rhythm and to create cross rhythms, but in performance terms this is perhaps less deliberately controllable and is certainly less performative since the delay time is limited to one of two values whereas the filter can be stepped between its ten frequency steps at will to create precisely timed rhythmic interventions. It is sometimes difficult to distinguish between Tubby's and Jammy's mixes but this can be partly explained by remembering that Jammy was Tubby's apprentice and that repeat business for the studio revolved around a house style. Rather than the technology solely determining this style, it is more plausible to assume that social and economic factors would have encouraged the convergence of each engineer's mixing style *within* the framework of limitations and affordances set by the available technological configurations. It is beyond the scope of this paper to analyse the different mixing styles of Tubby, Jammy, Scientist and the other apprentices, but such a study could build on the research presented in this paper and explore the preferences and refinements of each engineer's practice within the ecological context of a common set of tools and instruments.

On examining the instruments, and in particular the mixing desk, although most were of very high quality, it is clear that Tubby had to deal with and overcome severe limitations, and while it is certainly the case that some of the equipment lent itself to being used in a particular way, it was Tubby's expertise and creative imagination that exploited the affordances of these elements and combined them into a single musical instrument enabling the production of such inventive and enduring music. A grasp of these technical characteristics and limitations is essential for a complete musicological analysis of Tubby's creative music practice. This material research cannot be used in

isolation from the social, cultural and economic conditions centred around King Tubby's studio in the 1970s but offers as much detail as possible from a technical perspective in order to contribute to a deeper understanding of the performance ecosystem in which King Tubby's music evolved.

Acknowledgments

I would like to thank John Seman at The Experience Music Project, Seattle for granting me access to examine King Tubby's mixing desk and Chris Lane for the interview.

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