

Michael Connelly:

You're listening to *Killer In The Code: Solving The Black Dahlia & Zodiac Cases*. I'm Michael Connelly, and this is chapter 4.

Today, we're going to sit down with the professional code breakers that were brought in to independently back check a major breakthrough in these two infamous cases, but then proceeded to come up with two major breakthroughs of their own, and in the process, found the digital evidence that may solve another cold case. If I was writing this as a novel, it would definitely be a page turner. And that's sort of my task today, to try to take this highly technical story and turn it into everyday language that any listener can follow and understand. I'll do my best.

This all began with cold case consultant Alex Baber cracking the holy grail of Zodiac ciphers, the Z13, so named because it had only 13 digits, making it previously believed to be unbreakable. Z13 is also known as the My Name Is cipher, because the Zodiac boasted that he had put his name into the code. Efforts to break it were unsuccessful for 50 plus years until Baber came along and used a combination of AI-aided data crunching and legwork to weed through 71 million names and narrow it down to one. Marvin Merrill, also known as Marvin Margolis, one of the top suspects in the 1947 murder of Elizabeth Short, better known as the Black Dahlia.

Baber put together a team of investigators to help him look for evidence that would support his findings and lead to the solving of the cases that have fascinated people for decades. When I was asked to join the team, the first thing I did was look for the kind of professional cryptographer that would independently confirm or condemn Baber's work. If the entire investigation was going to be built on Baber's claim to have broken Z13, I had to make sure that claim was legitimate.

I reached out to Ed Giorgio, who spent 30 years with the National Security Agency and is the only man in the agency's history to hold both chief code breaker and chief code maker positions. Giorgio in turn brought in two other veteran cryptographers, Patrick Henry and Rich Wisniewski, to conduct a peer review of his work. Together, the three code breakers have nearly 100 years of experience, mostly working on classified projects for the NSA or its British counterpart, the Government Communications Headquarters. All three are still active in cybersecurity and sleuthing.

As reported in episode one of the podcast, the cryptography team confirmed the work Baber did in arriving at the name Marvin Merrill hidden in the Z13 code. In the *Los Angeles Times*, Giorgio called Baber's work the greatest sleuth story ever told. And as he continues work on the case, he is not backing down.

Ed Giorgio:

I believe that this was a monumental discovery.

Michael Connelly:

The world of cryptology is a mystery in itself. It's populated by mathematicians and cyber experts that speak their own language. Sometimes what they say is as hard to decipher as the codes they make or break. But the confirmation of Baber's breaking of the Z13 is based on several steps that identify the Zodiac's methodology and keywords that in a way act like the passwords we use on our computers and phones and websites in everyday life. Each step successfully taken reduced the possibility of error in Baber's work and closed in on Marvin Merrill as the only name that finally fit the cipher.

Ed Giorgio:

There are many people out there who correctly claim that you could make this cipher decrypt to any name you like. That's not quite true, but it's not strictly incorrect.

Michael Connelly:

That was Ed Giorgio again. I sat down with him and a member of his team, Patrick Henry, to discuss their work on the case.

Let's start with the original code maker. In this case, that would be the Zodiac. He wrote many catch me if you can letters to the newspapers in the '60s and '70s. Four of these included ciphers, starting with the Z408. Once again, the numbers in these code names reflects the number of characters in the cipher. It is standard knowledge in cryptography that the longer a cipher is, the better chance there is that it can and will be broken. The 408 code was presented in a grid. It was sent in three parts to three different newspapers. Most of it was broken within a week by a pair of school teachers. Not only was it long, but it was designed using only a substitution methodology, meaning that letters were replaced by numbers or symbols or other letters.

By studying the frequency of these characters and noting double letters and other anomalies, a de-encryption map could be arrived at that translated each character in the cipher's grid to the correct letter in the alphabet. There was an 18 character tale to the 408 cipher that was not broken, but we will get to that later in the episode. Possibly because his first cipher was so easily broken, the Zodiac made his second cipher, the so called Z340, much tougher. He used a substitution code with a permutation, which means the characters were shuffled in some way after the substitution process. Giorgio said it seems clear to him that the Zodiac stepped up his game with Z340.

Ed Giorgio:

He probably thought it would be hard to break if not secure, but it was broken. That taught him a lesson. The lesson it taught him was, "I need a permutation and I'm going to use the Knight's Tour." And that's what he did. And it went unsolved for 50 years. And I worked on it myself 50 years ago.

Michael Connelly:

The Z340 was also a grid cipher. It finally was broken just a few years ago by a team of mathematicians and cryptology enthusiasts. They identified the use of the Knight's Tour chess move as the permutation in the cipher. This permutation required shuffling the characters in the grid in the way a knight is moved on a chess board. That is two squares vertically or horizontally followed by one square to the right.

In late 1969, the president of the American Cryptogram Association publicly belittled the Zodiac's code making skill and challenged him to put his name in a cipher, expressing doubt that he ever would dare to do it. But he was wrong. On April 20th, 1970, the Zodiac's third cipher, the Z13, arrived at the *San Francisco Chronicle* with the Zodiac boldly claiming that he put his name into the 13-character string of symbols and letters.

By keeping it under 15 characters, the Zodiac most likely believed it was unbreakable. Most of the manuals and literature on code of the day told him so. But nevertheless, the Zodiac used two coding methodologies to double down and make sure. We'll get into the construction in a minute, but I just wanted to mention that the Zodiac's last known cipher came a few months later, the Z32 cipher, which we talked about in episode three. We'll also have more to say about that later in the episode.

When Ed Giorgio and his team took up the task of backtracking the work of Alex Baber, they were chiefly concerned with two things. The first was to learn how Baber broke the code and what methods he used to do it. The second was to put themselves in the Zodiac's shoes and learn what methods he had used to

compose the cipher in the first place. In a way, these were two separate investigations that would wrap around each other like a double helix. There were outside factors that had to be considered at the start, namely, how did the Zodiac learn cryptology? Baber believed that the Zodiac's code making had origins in military code work. This was not a new concept and the Giorgio team thought the same. We discussed this in chapter three of the podcast, but here is cryptographer Patrick Henry with a refresher on the materials that would've been available to someone encrypting messages in the late 1960s.

Patrick Henry:

The book that I believe would've been the most readily available was by Helen Gaines, and it's called *Cryptanalysis: A Study of Ciphers and Their Solution*. And you can see on the cover a sort of grid-based cipher right there. *The Army Field Manual on Basic Cryptography*, which was actually published in 1950 after the war. So it's not clear that he would've had access to that specifically, but other materials, similar materials, may have been available to him.

Michael Connelly:

Henry also mentioned a book originally published in 1916 called *Manual for the Solution of Military Ciphers* by Parker Hitt. In his investigation, Alex Baber spent two years working on Z13 in trying to identify the methodology used in the encryption. It was obviously a substitution cipher, but there was also a permutation that needed to be identified. Though the cipher was presented by the Zodiac on one line in the letter to the *Chronicle*, Baber noted that the other three Zodiac codes were grid ciphers. He decided to take Z13 and put it on a grid. That is, instead of keeping it on one line, he broke it into two rows of seven characters with the addition of a blank or a null to make sure there would be seven columns with two characters each.

That move by Baber eventually broke things open when he was able to identify the methodology used. The seven columns were shuffled first, and then each letter was replaced in the substitution scheme. Baber then spent nine months using an AI program to weed through all the names that fit with the permutation until there was one name left, Marvin Merrill. The Giorgio team followed the same path and confirmed what Baber had done. They found that the Z13 encryption method was a variation on the methodology used in the other Zodiac ciphers.

Ed Giorgio:

I know it's a difficult concept, but the permutation that Alex gave us, we believe is correct in part, because the method of encryption is very consistent with his prior methods of encryption, and what Patrick just said about the Gaines book that tells you this is the way to do it.

Michael Connelly:

If this was a movie, this is where the story would suddenly pivot and pick up speed. Ed and Patrick and Rich, the ex-NSA guys, didn't leave it there with the confirmation of Alex Baber's methodology and solution. They went from code breaking to code making. They started thinking like the Zodiac and how he would have composed the Z13 cipher. Every book and text and primer on code making, including those mentioned already, tells you to start with a keyword that can be used to compose as well as unravel the cipher. A word with at least six to eight letters that can be numbered in order of their appearance in the alphabet. The resulting number becomes the permutation key or the substitution key.

For example, if you have your message in a grid with, say four columns, you want a keyword that is at least four characters long. So say you use the word flag as your keyword. You start by placing F above the first column, L above the second column, A above the third and G above the fourth. Then you sort

the columns to put the letters of the keyword in alphabetical order, which with the word flag would be A, F, G, L. The A originally started above the third column, but A comes before all the others in the alphabet, so that third column gets rearranged to be in the first position, the first column. F would be the next letter in the keyword to come alphabetically. So the F column moves into the second position followed by the G column and then finally the L column.

You have now shuffled the columns. Cryptographers then typically convert such a keyword into numbers. The keyword flag, for example, would have a numerical of two, four, one, three, again, by sorting the letters of the word flag according to the order they come in the alphabet. The A comes first, so it gets assigned the number one. Then F is the second, so it gets the number two. G gets number three, and the fourth letter alphabetically is L, so it gets a four. So FLAG becomes 2413. It's complicated, and I hope I've explained it clearly, but you can go to our website to find links to sites that further explain this permutation, which is often referred to as a columnar transposition.

With the Z13 code, the permutation key, if it could be discovered, would reveal the correct order of the seven shuffled columns, and that of course would further confirm Baber's solution. Patrick believed that the sophistication of the Zodiac ciphers indicated that the man behind them would have used a key, so he started looking for it.

Ed Giorgio:

Patrick was convinced that the permutation wasn't random and spent days reverse engineering it. And I said to myself, "Geez, he's probably going down a dead path." And he kept saying to me, "No, there has got to be some way he came up with the permutation." And Patrick stuck it out, tried every combination, and so I had moved on. I didn't do that. So just shows what the value of a team is.

Michael Connelly:

The bottom line is Patrick found it. You turn a key to unlock a door. Patrick found that the keyword that unlocked the door on Z13 was "Elizabeth." And by the way, you can only use a letter once in a permutation key. So it became clear that the Zodiac had dropped the first E in Elizabeth.

Ed Giorgio:

That's an aha moment.

Patrick Henry:

Definitely.

Ed Giorgio:

So Alex recovered the permutation and Patrick figured out how it was generated in the first place. It was generated by a standard scheme using the keyword Elizabeth.

Patrick Henry:

That's something that really lends weight to this solution being correct. It's not just an anagram of the ciphertext, that you then apply a substitution to and get a random name. It's a very structured reordering using the kinds of permutations that were used in standard reference works. They all start with, "Okay, here's how to make a substitution. Now, here's how to make a permutation, which is commonly called a columnar transposition." And then a discussion of, "Okay, well, we want to combine these two in order to get us a cipher that's really resistant to analysis."

Michael Connelly:

It was a stunning discovery. Marvin Merrill had used the name of the Black Dahlia as the keyword to a Zodiac cipher. It was another irrefutable connection between the cases. All three parts of the crypto investigation came together, methodology, keyword, and solution.

Ed Giorgio:

So when people out there assert, "Hey, you can make this decrypt to any name you want," they are correct, but can you make it decrypt to something that has all these other attributes? Like we had prior knowledge that this was a suspect. Like we had prior knowledge of the encryption system. Like we had prior knowledge that this was this person called Elizabeth? You just can't put all those three things together and come up with the answer. Excuse me, come up with a believable answer. You had to take all three as a package.

The first thing is the suspect's name. The second thing is what actual encryption method was used? Not what the answer was, what was the method? And so, we think that his method looks very much like his prior methods. Also, the method is well-informed by the Gaines text. The third thing is, hey, a keyword actually generates the permutation. And what is that keyword? That keyword is Elizabeth. Oh my God, we got great prior evidence in favor of that. So what we see in the ciphertext, that crazy 13-long sequence is a precise mapping that all of those three assumptions have to be correct to get.

Patrick Henry:

At every stage in the way from the Z13 to Marvin Merrill, we have a believable, plausible method to get from one to the other, and they all kind of make sense and they all hang together. And generally that is not the case. If you have one of the other thousands of names that could fit in terms of having the right number of repeats in them, they won't necessarily match this permutation method with any permutation. And if they do, the permutation keyword might not be believable. And if they do, the name might end up being something that isn't the name of a real life person or a real dead person in this case. And if they do, then you end up with a substitution that has no known structure to it. But at every stage in this, we have structure. We have a method of construction that is believable, matches what was commonly described in texts and sort of builds in our confidence that this is the right solution.

Michael Connelly:

I asked Giorgio and Henry why they thought the Zodiac would use a keyword that if discovered could connect him to another case.

Patrick Henry:

I think he was trying to leave clues and he was trying to make it sort of tantalizing, but hard. And so, that when somebody did finally come up with the solution, they would be able to see how it was constructed and what the keyword was, and it wasn't just something made at random.

Michael Connelly:

The keyword discovery galvanized the cryptography team, because they now understood that if the Zodiac used a keyword for the Z13 code's permutation, then he most likely used a keyword for the substitution scheme as well. Once again, they were back in the Zodiac's shoes, figuring out what steps he would've taken.

Patrick Henry:

I think he would've started with writing his name in the grid and thinking, "What do I do next? Okay, I do a permutation. So I'll come up with a keyword, use the keyword to make a permutation. All right, I'm going to use Elizabeth." And so, he used Elizabeth and then reordered the letters. And now just reordering the letters is not going to be anywhere near secure enough, so you have to have a substitution as well. And how do you come up with a substitution? We don't know how he came up with the substitutions for his earlier ciphers. We do believe that he used a keyword for the substitution in Z13.

Michael Connelly:

Having brought in late to Patrick's belief that there was a permutation keyword, Ed dove headlong into the search for a keyword to the substitution scheme in Z13. He worked it night and day, and on Thanksgiving morning, he was once again back in front of the computer. Earlier, he had identified the exact mapping of symbols to letters in the code. He now had to find the keyword that corresponded to it. An exhaustive search came up with 19 possibilities. Most of these words were nouns, verbs, and adjectives like ascending, freighter, and cherished. Only three of the 19 words were recognizable as names. Siegfried, Fredrico, and Cheri Jo, with Cheri spelled unusually with a C and Jo without an E.

The names and words meant nothing to Giorgio. He fed them into an AI program and asked if any of the words on the list held any significance in either the Zodiac or Black Dahlia cases. The answer was immediate. Cheri Jo Bates was murdered in Riverside, California, in 1966 and thought by many to be, but never officially declared by police to be, a victim of the Zodiac.

Ed Giorgio:

So this was kind of the second aha moment.

Michael Connelly:

Cheri Jo Bates was an 18-year-old college student at Riverside Community College. She was murdered on the night of October 30th, 1966, shortly after leaving the school's library. Her car had been disabled and she walked off with a man promising to give her help and a ride home. She was slashed and stabbed during a struggle and her body was found the next morning. Police determined that the distributor on her Volkswagen's engine had been disconnected, which indicated her murder was premeditated.

In the weeks that followed, police and local newspapers received a variety of letters from her alleged killer. Most were proven to be hoaxes, but one so called confession letter was determined to be from the actual killer because of the details it provided, including that he had pulled the middle wire on the Volkswagen's distributor. Police also recovered a wooden desk from the library with references to Cheri Jo's murder written on it. This was also determined to have been the work of the real killer.

Three years later, with the murder unsolved, Riverside detectives noted the similarities to what was happening up in the Bay Area with the so called Zodiac killer. He too had a pension for reaching out to newspapers and through them to the police. The Riverside detectives met privately with their Bay Area counterparts to compare the cases, but the possible connection between the cases was not exposed publicly until late 1970 when the *San Francisco Chronicle* reporter, Paul Avery, later to be portrayed by Robert Downey Jr. in the movie *Zodiac*, broke the story. There were several intriguing connections between the cases, including the use of similar words and duplicate misspellings in the letters from the Zodiac and the Riverside Killer. For example, both used the word twitch in their writing, both misspelling it the same way.

In a newspaper interview with Cheri Jo's father a year after the murder, he spoke of the loneliness in his life since losing her and could only refer to her killing as "this thing that happened". Two years later, but before the possible connection between the cases were revealed publicly, the Zodiac said in a letter to the *San Francisco Chronicle*, "I get awfully lonely when I am ignored, so lonely I could do my thing."

While there were many other similarities, there were things that didn't quite fit. The specific targeting of Cheri Jo as opposed to the seemingly randomness of the Zodiac killings. The distance between Riverside and the Bay Area. The fact that the Riverside confession letter was typed and all the Zodiac communications were handwritten.

Though in the years that followed, the FBI investigated the possible links between the cases, the investigations were never fully and officially combined when the differences seemed to outweigh the similarities.

The team investigating Marvin Merrill believes they are now inextricably linked, because the Zodiac used Cheri Jo as a keyword in composing the Z13 cipher at least four months before the *San Francisco Chronicle* and Paul Avery broke the story that the cases might be linked. This is veteran homicide detective Rick Jackson.

Rick Jackson:

That's a mind-boggling fact that would rivet any detective that was connected with an unsolved murder, the unsolved murder of Cheri Jo Bates. What are the chances that, that kind of thing happens, that the killer or potential killer includes her name in a cipher keyword when the cases haven't even been seriously looked at or connected until months later by an article in the *San Francisco Chronicle*? It's off the charts. That kind of stuff just doesn't happen.

Michael Connelly:

Mitzi Roberts, the former supervisor of the Los Angeles Police Department's cold case unit said the Cheri Jo keyword confirms the connection to the Zodiac and says it offers valuable insights into the killer's evolving MO.

Mitzi Roberts:

What are the odds that those keywords would be the exact names of two of the most famous unsolved, gruesome murders, similar murders, by the way, gruesome murders in California history?

Michael Connelly:

Cheri Jo Bates was slashed and stabbed. Two years later, the Zodiac began his murder spree using a handgun. Roberts says that it is not a reason to view the cases as unconnected.

Mitzi Roberts:

In every killer, you see that a lot, the evolving of an MO, things that works, things that didn't work. There's a lot of risk with a murder like Cheri Jo, where you're murdering somebody in public. She was kind of secreted in between two buildings, but it's in public, very bloody. You're coming out now onto the street covered with, I would imagine, blood and evidence. And there was said to be a huge struggle, which that is going to alert people, alert law enforcement. And so, these are things that would've went wrong for the killer, that he's going to try and perfect. A serial killer, he's going to try and perfect and get better, because he doesn't want to get caught. Even though he's taunting law enforcement and he's saying, "Catch me if you can," this is a game to him and he wants to keep playing.

And so, with the Zodiac, yeah, he sneaks up. Very sneaky. They don't even know that he's there until he's right there in the window of the cars. More planning and just he's perfecting. He's perfecting his game so he can continue to do it. And anytime you use a gun, I think you have less. It's quicker, it's less personal. You can keep a distance from your victim. You have more time to just get away without a bunch of evidence on yourself. As we start to fill in those gaps and things start to fall into place, we see the killer evolving and getting better at his craft. And there's a reason why he wasn't caught, because he did evolve.

Michael Connelly:

It should be noted that Marvin Merrill initially checked some of the boxes in relation to the Bates murder, namely proximity. At the time of the murder, he was living an hour and 15 minutes away in Vista, California. He also was operating an auto repair business at the time called Buck Savers, which would have likely given him the knowledge of which wire to pull in a distributor to disable Cheri Jo Bates's Volkswagen.

Alex Baber's team is continuing the investigation of Merrill's connection to the Bates murder, and we will have more on that in later episodes.

Let's go back now to our cryptographers. Their work on this project certainly gives legitimacy to Alex Baber's work and claim that Marvin Merrill, born Marvin Margolis, is the killer of Elizabeth Short as well as the victims of the Zodiac spree. I asked Baber about this.

Alex Baber:

I think that this alone validates my initial discovery and findings of Marvin Merrill as being the solution to the Z13, as well as I think it adds another layer of credibility because it was independently discovered. It wasn't in-house to me or my team.

Michael Connelly:

Another game changing confirmation came in last week from Stockholm, Sweden, where a data analyst reported a startling new insight on the Zodiac's first cipher, the Z408. This was the cipher broken very quickly in 1969 by school teachers, Donald and Bettye Harden, except it wasn't completely broken. The last line of the cipher, 18 characters long, was not decoded and has remained so ever since. Over the years, it was thought to be gibberish or a line of meaningless symbols used to even out the three grids that comprise the cipher. The last line became known informally as the Z18. Last week, Thomas Hefner of Stockholm, reported that he applied methodology employed by Baber in breaking Z13 to the so-called Z18 and was able to decrypt it. He says it contains a name, Marvin Merrill.

Hefner has no background in cryptography, but works for a tech investment firm in Stockholm and specializes in pattern recognition and hypothesis validation. He also attended college in Los Angeles and was familiar with both the Zodiac and Black Dahlia cases because of movies he saw that were based on each case. He saw news stories on Alex Baber's discovery and looked for pattern similarities between Z13 and Z18. He noticed that if you discounted the five Es contained in Z18 and applied Baber's methodology to the remaining 13 characters, you got the same result. Hefner told me he was excited by the discovery, but also a little bit spooked.

Thomas Hefner:

The work itself was about seeing the patterns and trying to understand the system itself behind it. And it sort of puts you in this space where you are trying to. You feel at least like you're thinking like the

person who created these patterns and the system. And you realize that you're suddenly getting in the head of the killer, the serial killer, and it's an eerie feeling.

Michael Connelly:

Hefner's work has been confirmed by Baber.

Alex Baber:

It's solid. It's rock solid. I tested it first, twice, to make sure it was accurate, it was. I therefore shared it with Ed.

Michael Connelly:

Giorgio and Henry are still reviewing the construction of Hefner's solution to Z18, but told me that their initial review of it found it to be plausible.

I want to finish up here with Ed and Patrick. I asked them to review Baber's work on the Z32 cipher, which was part of the discussion in chapter three of the podcast. I asked for a no holds barred review. This is Patrick Henry.

Patrick Henry:

The Z32 has a similar property that you can have lots and lots of solutions. So it's really hard to build confidence in the correctness of any given solution, because in a sense, almost all solutions are valid. I think Alex has some really convincing evidence outside of the cipher where you take that large circle cross, he's got a very heavily inked in zero, and you line that up with the map and put the center on Mount Diablo and you end up with the burial location of Elizabeth Short. And yeah, we verified that with the map. That certainly lines up. That all seems very plausible. The question of how would you get from the given plain text to that cipher text? We don't have any sort of convincing argument that this solution is structurally any better than any other solution. The evidence that Alex points out that is outside of the cipher has some weight to it.

Michael Connelly:

Henry said that because the Z32 cipher was a simple substitution code, there are no keywords that can be found to confirm a solution.

Patrick Henry:

That was the way that we kind of built confidence on the Z13 solution is looking at how would you construct this? And when we found out, okay, this is how you construct it and you end up with these keywords that are highly relevant to the case being the keys, that really cemented it for us. But we don't have that for Z32.

Michael Connelly:

Before signing off with the cryptographic team, I had to ask Ed Giorgio why he pitched in and built a team to help confirm Alex Baber's solution to the Zodiac code.

Ed Giorgio:

We believe that this was a monumental discovery. We were asked by you to verify the result. So this is the normal experimental science thing that cryptanalysts do every day. This is my passion. It's

enormously fun. I'm not getting paid. And I have very important other work to do, where Patrick and I and Rich are finding the bad guys on the internet. Now, that's a research and development program because it's a work in progress, but I have a strong connection to the history of code breaking. A story like this, I'm sailing a little close to the wind, because we're showing cryptanalytic techniques that would have been considered classified in the day they were used. Some of them are still considered classified today, but we're in it to solve important problems. We think this is important, but we also think it's terribly exciting.

Michael Connelly:

We'll be back with a new episode of the podcast on the anniversary of Elizabeth Short's death when the investigators take it to the street in search of the place where the Black Dahlia may have been murdered.

I'm Michael Connelly, and you've been listening to Killer In The Code: Solving The Black Dahlia & Zodiac Cases. This episode was written and produced by Michael Connelly. It was edited by Terrill Lee Lankford, with sound designed by Michael Odmark, and music by Mark Henry Phillips. Subscribe to the podcast so you'll be informed of new episodes and check out killerinthecode.com for information on the investigation. Thank you for listening.