The origins and intentions of the Hunt

We began thinking about the ATH a year ago. The idea of the Hill cipher occurred to me while talking to some undergraduates, but we soon discovered it was a known code, devised by Lester S. Hill, which had not previously been used in the ATH. Paul had read "The Thought Gang" and was taken by the idea of "The getaway lunch." Having performed a successful robbery, the gang would enter a nearby restaurant and have lunch while the police assumed they were making their escape. We toyed with the idea of using restaurants in the vicinity of bank robberies, but this was felt to be too limiting. So we decided to broaden the scope to "bank robberies" in detective fiction.

These are surprisingly sparse. Your mainstream private detective leaves such dull things to the police, and it was only the Precinct 87 series where we had a fair number to choose from, mostly involving the Deaf Man. Conan Doyle only had one, Christie barely any. Stout none at all. I then noticed "The Rubber Band" wasn't far from "The Bank Robber" and went with that, although it could be considered a corruption of our pure ideal, even with the "somewhat stretched" admission. Once we'd swallowed that as an acceptable thematic link, anything was possible and we were away.

We wanted an author with a link to the London area, and Ruth Rendell soon came to mind, especially when we found an easy route from her plaque to Epping Forest.

Our original idea was that several setters would each produce a couple of pages to be spliced together. In the event, this didn't quite work out as the band of setters shrank and the majority of the pages were written by me, while Paul Barden devised his epic EXIF trail. Dale Johannesen volunteered as the checker and his help was invaluable – both in correcting my mistakes and as an indicator of what was too obscure or inelegant. Armed only with preknowledge of the intended themes, he solved almost all the Hunt single-handed. I should mention that the copying error where I missed out the leading letter in a playfair code was introduced AFTER he had checked it.

There is obviously a conflict between making a puzzle both challenging and yet eventually solvable. We wanted a fair number of teams to find the box, and we wanted solvers to make continual progress rather than being stuck until a sudden epiphany. So we broke the instructions down into bits, some of them intended to be easy, one on each page. We knew it might not be necessary to find all the instructions to find the treasure.

We also tried to include subsidiary indications so that people who couldn't decode the starting instruction might guess it. Scattering Rendell references throughout the Hunt would start people thinking about her. Biographies and obituaries might mention her blue plaque and the story about her reporting a speech neglecting to mention that the speaker had died. The Foresters arms with the bike on the roof might be identifiable. The EXIF code included a mention of nearby Debden.

We hoped 15- 20 teams would find the box, and in fact 21 did. But we also wanted something a little deeper to keep the quicksolvers occupied. We had wondered about including references to past hunts and Paul's elaborate EXIF trail resulted. Very few teams found the ATHEXIT page, despite it being locatable from an armchair. We strung the final stages of the EXIF trail together in the last few days – even hours - before release. I don't recommend this procedure to future setters! Indeed, an error crept in, which we hope we corrected before anyone was inconvenienced by it.

When we decided upon the Treasure site the ground was fine, but on our second visit to photograph the route the approach had become a bit muddy. Hence the Newsletter began to mention mud to allow us to develop that theme if needed. We hope it wasn't too bad during any of your visits.

Structure and Themes: Apart from the cover page, which contained a link to the 10 non-thematic pages, each page was associated with an author and a particular book. With the exception of the Ruth Rendell page, copious references to these were scattered in the questions and pictures. Each non-Rendell page also had a Rendell-reference of some sort. The Rendell-page had its theme concealed. Each page had some sort of reference to a bank robbery, a reference to a Hunt/hunter and a reference to a hill. Page 7 also included many references to the "wrong" Thought Gang.

P	Author	Thematic Book	Rendell Ref	Hunt Ref	Hill
2	Conan Doyle	Red Headed League	Crocodile Bird	Violet Hunter	Lester S Hill
3	Rex Stout	The Rubber Band	Rottweiler	Father Hunt Mother Hunt	West Hills Rex Hill
4	Agatha Christie	Million Dollar Bond Robbery	Fallen Curtain	HunterChristie Hunter'sLodge	Bexhill-Bex
5	Neil Gaiman	American Gods	Wexford	Hunter Q3	Hill House
6	Ed McBain	(Let's hear it for) the Deaf Man	Haydn	Evan Hunter	Hill's Vortex
7	Tibor Fischer	The Thought Gang	Barbara Vine	Tim Hunter	Fischer Hill
8	Alistair MacLean	The Satan Bug	1 Across/2 Down	MacLean Hunter's Kilt	Stuart Hill MacLean Hill
9	John Steinbeck	How Mr Hogan Robbed a Bank	3 Edgars,Martin Beck,CBE	Major Hunter Q1	Lennox Hill
10	Ruth Rendell	Make Death Love Me	N/A	Hunter's Hill	&Braile's Hill
11	Joanna Rowling	Harry Potter and the Deathly Hallows	Portobello	HeadlessHunt Sagittarius	Stoatshead Hill
12	Emile Gaboriau	File 113	13 steps down	Chasse pour l'honneur	Rooster Hill Cock Hill

The Main Codes

The main codes appeared in "letter-boxes" on each page. The number of letters in the border indicated how many letters there were in the alphabet on which the Hill cipher on that page was based. This varied less than was originally intended, and was either 26 or 25, for reasons explained below.

On most pages, an acrostic defined a codeword used by the first line of the code, usually a Playfair as strongly hinted by the Newsletter. This then gave the 2nd codeword and that solution gave the 3rd. Our Playfair codes always use a key word or phrase which has no repeated letter (and written in the Playfair font). This is conventional and aesthetic – it enables intelligent guessing of the key, weakening the security but adding to the solvability, and hopefully the entertainment. On the 3 occasions when the key was a single dictionary word, I artificially added a letter, (A, T or H) so that the key wasn't so easy to find by brute force. There was no significance to these letters other than spelling ATH.

Hill ciphers have not to my knowledge been used before in the ATH, but they are a simple and elegant manner of encoding several letters at a time. For example, a vector of three letters (x,y,z) is first written as 3 numbers using a=1, b=2 etc. The letters can be encrypted into three others (a,b,c) by multiplying the number vector by a suitable 3 x 3 matrix. The matrix can itself be a word or

phrase. The decryption process involves multiplying the encrypted vector (a,b,c) by the inverse matrix, provided it exists. All arithmetic is done modulo the alphabet length (26 or 25). The inverse exists if the matrix determinant is coprime to 26 (or 25). The encryption matrix was for aesthetic reasons defined by a codeword or phrase which was required to have a square number of letters (4, 9, 16 or 25). Again, this made it sometimes possible to guess the codeword (e.g. finding a book title with 16 letters), but this was all part of the game.

Many teams were more than capable of writing software to process Hill encryption/decryption, but I did not want to make such a talent necessary. I also did not want to make people invert 4x4 matrices by hand. There are a few public sites which process Hill encryption automatically, and I was happy that people should use these.

  Unfortunately, this introduced limitations. I had intended to use other alphabets, e.g. 36 characters including digits, or punctuation and/or spaces. But many of the public sites couldn't cope with that. I also hit a mysterious bug with one otherwise reliable site falsely stating that the 5x5 matrix KISSI NGTHE GUNNE RSDAU GHTER was not invertible modulo 25. So I changed that page so that this matrix was the DECRYPTION rather than the ENCRYPTION matrix like all the others. All that was needed was to multiply the ciphertext by the given matrix (that is to "encrypt" the *ciphertext* with this matrix.) This nevertheless caused some difficulties for Hunters. I thought the phrase "DECRYPT, I SAID DE!" would indicate clearly that the matrix wasn't an ENcryption matrix like the others in the Hunt, but some read this as "DECRYPT IS AIDDE" and were baffled. In the words of the Baroness, this was clearly "A fatal inversion".

Variants: Some pages used Vigenere codes, heavily hinted, for variety and in red for no real reason.

Page 2: I gave the ciphertext for a character (JABEZ WILSON) AND A 2X2 MATRIX. Only 4 letters are needed to find the encryption/decryption matrix, showing how vulnerable the cipher is if you can guess any of the decrypted phrase. Some teams used a computer for all possible 2x2 matrices to solve this. This then gives a hint to the playfair key NOSLIWZEBAJ – normally the Hill cipher is the last in the series.

Page 10: The thematic page. There were many differences between this page and the rest, which was intended as a pointer that it was special. To make the page harder, I Caesar-shifted the acrostic by one letter, used two Hill ciphers, one of which was the abovementioned 5x5 encrypter. The chess puzzle gave the key to a Vigenere which mentioned the Caesar-shift. This slowed down some teams a little, though some found the key without looking at the chessboard.

Page 12: Paul had the idea of clueing the matrix numbers directly from a thematic book, and chose "File 113" for this purpose. This book is available on Project Gutenberg ◙ (seen that symbol before? Perhaps I should have made it bigger…)

Substitution codes: there were two of these. On the front page there was a link to PABLOSATH.COM/CHRISTMAS.HTM (and later on the site to /CHANUKAH.HTM). The other, on page 10 "Huloo hehmor slo ef huo Foyr. Huer er ath an algol." With honest punctuation and spacing this is easy enough to break once you try letter substitution. I'd chosen letters so that ath appeared and then made the 2nd sentence vaguely word like. To my surprise, the 2nd sentence if typed into google-translate, claims it's Luxembourgish! This is entirely spurious, and should serve as a warning to us all. The text decodes to "Three titles are in the News. This is out of order." The two sentences are independent; the blue one refers to the Newsletter and the presence of 3 Ruth Rendell book titles in the text. (I'd toyed with a 4th, "End in tears", but was afraid this would sound suspicious and might give her away before the Hunt was even released…) The 2nd sentence, referred to the fact that the

page was out of order, as it clued the blue plaque, the starting point. All other pages are in order of the directions to the box.

Morse codes: The dots and dashes without spaces should not have been too difficult (HILL HOUSE, though less plausible answers exist). The sentence beginning "Australian disliked…" on P10, was next to a picture of Inspector Morse. The code (devised by Dale) is simply to look at the dashes on the t's and f's and the dots on the I's and j's and ignore the rest. Doing that gives the name of a young chess player, associated with the first of the chess problems above it.

Chess problems: There is an addictive form of chess problems called "Proof Games", where the aim is to find the unique sequence of moves reaching a given position in the specified length. A variant, is to find games uniquely determined by the final move(s). Thus, in the Newsletter I asked you to find the only game ending 5 Ke5, Qa5 mate. The solution is 1 e4 Nc6 2 Ke2 Nd4+ 3 Ke3 c6 4 Kf4 Ne2+ 5 Ke5 Qa5. I judged this to be of the right difficulty, and would give a pointer to what is required on the chessboard on page 10. (If you look at the letters on the squares on which the pieces land this solution spells out SNL5ONBLT3, the other blue code on P10).

The chessboard on P10 spells MOVE FOUR A PAWN UP…(gibberish)… TO B5 MATE. Interpreting this as 4b5 mate (by white or black) leads to the only solution

1 d4 c6 2 Kd2 Qa5+ 3 Kd3 Qa3+ 4 Kc4 b5 mate

The squares landed on spell 5NG3MATE. Interpreting this as "Find the only game ending 5Ng3 mate" leads again to the unique solution

1 e3 e6 2 Qg4 Ke7 3 Ne2 Kf6 4 Qxg7+ Kf5 5 Ng3

This time the letters spell out OPENLOPEZ. If you google that, you'll find the Chess Opening

1 e4 e5 2Nf3 Nc6 3 Bb5 a6 4 Ba4 Nf6 5 O-O Nxe4….

which finally spells out STONEBOOTS. This is the codeword for the Vigenere code to its right, which decodes to CAESAR SHIFT ACROSTIC, indicating that the acrostic on that page for HARM DONE was shifted one letter to IBSNEPOF. There were two subsidiary pointers to STONE BOOTS: The picture of Emma Stone with an arrow at her boots and the "unusually heavy footwear" in the Newsletter.

"Stone Boots" holds no significance – it wasn't easy to get the unique solutions and the instructions and a keyword into one diagram. I did have some flexibility and so could put words like BANK and JINGLE into the diagram. I slightly regret not swapping the 9 and the) in the 2nd row which would have made the initial instructions clearer at the cost of losing the irrelevant "2019". The puzzle has one slight flaw – I couldn't specify that 5Ng3 mate is by White not Black. There are solutions (with nonunique move order) ending 5…Ng3 mate for example. 1 e3 e5 2 Bc4 Nf6 3 Kf1 Ne4 4 Qe1 Qf6 5 h3 Ng3. Anyone who points that out will get a bonus mark. On the other hand, many puzzles have plausible solutions which don't work – maybe I'm being overperfectionist, but chess problems are meant to be my forte. Incidentally, if you like this kind of problem, I have put some others on the SPORCLE puzzle site sporcle.com/playlists/A_O_D/chess-construction-tasks.

The Draughts puzzle on page 9 is similar. The squares spell "White plays first and up…"

So who is white and how should they play? The position looks as though it should be a draw, but in fact the grey pieces have a tactical win. I'll plagiarise the diagram created by the Pathfinders team to illustrate this:
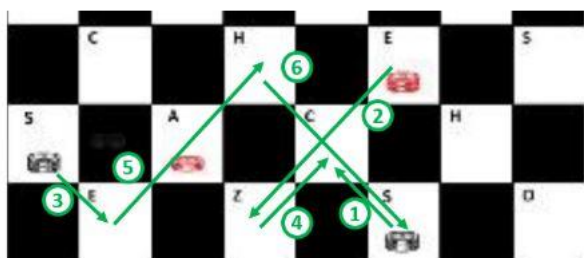
After White's move (1), sacrificing a king, red must capture (2) and after (3) he is in Zugzwang and has to allow a lethal double capture.

The squares landed upon spell out CZECHS, which is the keyword for the Vigenere code to the right. That gives "Not A Chess Grandmaster", which pointed to the Newsletter article on the Czechs, referring to a grandmaster title awarded in 1997. You might be forgiven for guessing it would be a draughts title, but in fact it was for crime fiction: Ruth Rendell from the Mystery Writers of America.

Other codes: Alistair MacLean wrote a book "Fear is the key." Dale pointed this out, so I introduced Playfair, Vigenere and Hill codes all using FEAR as the key on page 7. They decrypt respectively to: IS THAT SO? GOOD IDEA; BRAVO, A RED HERRING! You'll get points for these, and points mean prizes.

On the cover page, there is a letter-box with PABLOS ATH and a cipher text. This is a 3x3 Hill cipher with key PABLOSATH, giving EACH PRIME LETTER. This was a hint towards the obviously artificial paragraph in italics. Taking each letter in a prime position (2,3,5,7,11…) spells out A BOAT RIDE IS NOT NEEDED BUT WATER IS NEAR. This was intended as encouragement when you identified the ponds as likely treasure locations.

OREOS: I had been intending to include some sort of alliteration code in the Hunt, possibly relating to Ruth Rendell, but this didn't come about. Then, when I was writing the cover page with the gratuitous Paltry Production, Scarcely Substituting, Feast of Fun, Previously Planned, Triumphant Treasure-seekers, quite by chance I noticed the repeating letters PSFPT were a shift of OREOS. If this was deliberate I have a strange subconscious, which was ordering me to include it. So I gratuitously included some Oreos (rich desserts) in the box, which wasn't big enough to feed all the teams.

The Exif puzzle – by Paul

Ten years ago we carelessly left metadata in our route photographs, enabling solvers to estimate roughly how far apart they were. So this time we checked what was there…

Each of the 11 route photographs in the pdf contains a hotspot linking to a webpage with a larger version of the photograph. The pagenames are all of five characters, one of which can be removed to form a new word. The removed characters spell "Merry Xmas 19" [1] (the last two pagenames "t1ake" an "aw9ay" give this away in two ways). *Note: Numbers in square brackets relate to the scoring system.*

The first two photographs come with the text "Hind is readable" and "Now we comply". On the linked webpages this has become "Hex I find is readable" and "Now we complexify". The astute solver will note that "Exif" was previously missing [2]. (This sort of clue, solved by identifying the word omitted, is known by crossword compilers and solvers as "Printer's Devilry", abbreviated to "PD".)

Exif ("Exchangeable image file format") specifies metadata in images, among other things. So look at the metadata – Windows File Explorer for example will do it (right-click, Properties, Details).

The first fields to look at are the date taken, the comments, and the program. The date taken gives the release date, and if recorded in the ATH archives the release time, of a previous hunt. The comments contain a coded message. Six of the comments are in Hex ASCII. If you too find this is readable, the first photograph tells you "The date helps solve the code" [3]. That's intended to suggest that the code used in the comments field comes from the ATH whose release date is given.

Picking the low-hanging fruit, read the other Hex ASCII comments. These all come with author "G&S" and give you five lines of the "Patter Trio" from Gilbert & Sullivan's *Ruddigore* Act 2 [4]. The verse gives some teasing allusions to subjects and questions and letters, but the true meaning is given in the preceding chorus "So it really doesn't matter". The verse is filler because we had more route photographs than genuine clues, and we remembered a coded quotation in the 1998 hunt "The meaning doesn't matter…" from Bunthorne's patter song in *Patience*. We told you which pages do matter using the exif star rating field – the important ones get five stars, the rest two stars. Two stars because that's what a Major General gets in the US army, and Gilbert and Sullivan's best known patter song is…

In the five photographs with encrypted comments, the comment is to be decoded using a code from the corresponding ATH. If we saw any ambiguity about this, or if a keyword was needed, the exif program field gave a pointer into the solution document [5], eg "Sol p20 (short)" means look at page 20 of the solution document and use the shortened version of the keyword.

Whether or not you enjoyed revisiting the old codes, you should now have five more lines of instructions [6]:

"The author has the copyright."
" Look at the answers through the lens to form a word." (Regrettably the minion assigned to encode this message mistakenly used the previous message instead. We send him to trudge up and down a muddy path in Loughton until he was properly sorry. Which did make the mud worse, but it had to be done. Our apologies for the error, which was corrected on 30th December, but not for the mud.)
 "Note the camera make and look for the word at the front of it. If you find the word, use the next one of the same length instead."
"Each word is a step on a long path from here."
"Step in date order of the subjects"

It's time to look at the author field. These all look inappropriately geographical, so try abbreviating them – AL, SHRT, MA, BG, PC, SG. These are the initials of the authors of the six corresponding ATHs [7], but in a different order. (Some solvers noted that it would be more regular to abbreviate Pitcairn to "PN". We admire their precision and refer them to Ralph Waldo Emerson on consistency.)

"The author has the copyright", so use each author's ATH to decode the copyright field, which is a list of question numbers . If you don't know what to do with the question answers, look at them through the lens, which is either "First 1" or "Sig 1", meaning take the first letter or take the first significant letter as identified in the ATH [8]. This should give you six words: "heard", "deposit", "manager", "little", "wads", "incinerator" [9]. (There is an actual Japanese lensmaker "Sigma" .)

"Note the camera make and look for the word at the front of it. If you find the word, use the next one of the same length instead.". The camera make on five of the pages is "DLM". "Make DLM" is

Make Death Love Me [10]. And the camera model is "Ch 1" – chapter one. You'll find the corresponding five words in the first few paragraphs of *Make Death Love Me* (which are readily available online). Replacing them as instructed, your six words are now "office", "cashier", "balance", "money", "safe", "incinerator" [11]. The five new words are all thematically bank related, which wasn't hard to arrange since the book starts in a bank.

"Incinerator" refers to the Bank of England incinerator in Debden, a mile or so from the treasure site, where rogue employees notoriously and thematically stole over £600,000 between 1988 and 1992. [12 for mentioning the theft]. We included "DEB DE N" in the Enigma cipher header [13] as a pointer to this (and mentioned PABLO too, following the example of the Enigma ATH).

A few solvers read "DLM" as "Definition & Letter Mix" which is another sort of difficult crossword clue, often used in combination with PD clues. That's a good spot and an unlucky distraction.

"Step in date order of the subjects". So we need to understand the Subject clues, and the similar-looking Title clues. These are Printer's Devilry also [14], and give the subjects or titles of the six ATHs, again in a different order. The solutions are "Enigma", "Sayers", "Tarot", "Wasted", "Life", "Iain Banks" [15] [alternative PD clues submitted which we like will be credited].

Rearranging the six words in date order of the subjects, we get "office", "cashier", "balance", "money", "safe", "incinerator" [16].

"Each word is a step on a long path from here." Whereas walking long and muddy paths is some people's idea of fun, this part of the ATH is online, where a path is the human-readable form of a file-system address, essential in the construction of Uniform Resource Locators. "here" is simply pablosath.com, where you found the photographs. So try the URL https://pablosath.com/office/cashier/balance/money/safe/incinerator . That gives you an error message, but also the suggestion that you add "index.htm". And why not. https://pablosath.com/office/cashier/balance/money/safe/incinerator/index.htm finds ATHExit [17], and the (pictures of) gold coins you deserve for your successful endeavours.

[There is also an encouraging message under https://www.pablosath.com/office/index.htm . With two days to go we hinted on the site that PATH might mean URL, "Unremitting, relentless labour".]

Annotated pages: We now present the solution to the hunt by annotating the pages. Please tell me if I forget to mention something. We shall also publish some submitted solutions, which are possibly more clearly displayed. Naturally, we don't guarantee that all that is written in those is correct.

"No nuts or spoons"   Treasure tree, decked with holly.   The bench, with the bike just visible.