To: On the Same Page Group **April 2, 2013**
From: Henry E. Brady
Re: Thematic Outline of *Turing's Cathedral*

In the attached table I have identified nine separate themes in *Turing's Cathedral*. These nine themes can be further classified into discussions of (1) institutions, (2) people, (3) math, logic, and theory, (4) building and using computers, and (5) the future. In the prose below, I indicate the kinds of discussions that each could generate.

Institutions: Princeton and Institute for Advanced Study (IAS) – What kind of an institution was the Institute for Advanced Study? How does an institution like IAS contribute to the world? How does an institution's identity and self-definition affect what it does? How did computing come to IAS? What role did the military play? What kind of people were brought there to build MANIAC? How did they fit in? Were there tensions between IAS and the MANIAC project? Why? Why did the MANIAC project end?

People: John Von Neumann – What kind of background did Von Neumann have? What kind of mathematician was he? What role did he play in bringing MANIAC to the IAS? How did he relate to his second wife, Klara Dan (Klari von Neumann)?

People: Godel, Turing, Klari Von Neumann, and Ulam – Where was each person from? What impact did the rise of the Nazis and World War II have on these people? What role did each play in the development of computing and/or the development of powerful bombs? What did each do? What role did Kari von Neumann have? How did she overcome the typical role of a woman at that time? What did she help to invent?

Math, Logic, and Theory: Theory of Computers and Algorithms – What is the basic logic of a computer? What are bits, bytes, and kilobytes? What is computer memory? What is a stored computer program? What did the von Neumann memo on computing do? How did it define computing for decades and up until the present time? What are the "organs" of a computer? What kind of machine is a "Turing Machine"? Why is Turing's work basic for computers? What kind of method is the "Monte Carlo Method"? Why did it require computers? How did it change the way scientists do their work?

Building and Using Computers: Building MANIAC – How did wartime work on electronics, cryptography, artillery, and bomb-making contribute to the development of the computer? How did competition matter for the development of the MANIAC? What physical, as well as

intellectual, obstacles had to be overcome to build a computer? What kinds of people collaborated to build the MANIAC?

Building and Using Computers: Making and Delivering Bombs to Targets -- What were the problems facing those who wanted to deliver bombs to targets and to maximize their destructiveness? What role did shock waves play in the development of the atom and hydrogen bombs? Who was Oswald Veblen (and who was his uncle)? Who was Norbert Wiener? Who was Edward Teller? How did computers contribute to building bombs and finding ways to effectively deliver them to their targets? How is basic physics involved?

Building and Using Computers: Modeling Evolution – How do information and code (just like computer code) matter for evolution? How did Barricelli try to model evolution? What are cellular automata and what do they have to do with evolution?

Building and Using Computers: Forecasting Weather – What kind of physics problem is weather prediction? What did Lewis Fry Richardson try to do? Why did he fail? How could computers help? How much have they helped at short-term (one week ahead), medium term (months and years ahead), and long-term (decades ahead) weather prediction? Why does it matter?

The Future: Future of Computers – Where has computing gone? Where is it going? Will computers take over the world?

	Institutions	People		Math, Logic, and Theory	Building and Using Computers				The Future
Themes ➔ **Chapters ⬇**	**Princeton & Institute for Advanced Study (IAS)**	**John von Neumann (JVN)**	**Godel, Turing, Klari VN, Teller, Ulam**	**Theory of Computers & Algorithms**	**Building MANIAC**	**Making and Delivering Bombs to Targets**	**Modeling Evolution**	**Fore-Casting Weather**	**Future of Computers**
1 1953	X Three Revolutions:			X Computers Bits/Bytes	X Computers	X H-Bomb	X DNA		
2 Olden Farm	X IAS Site History								
3 Veblen's Circle	X Veblens, Flexner					X Veblen; Aberdeen; Wiener			
4 Neumann Janos		X Family History; Prodigy				X Shock Waves and Bombs			
5 MANIAC	X (81-87) IAS Project	X Brings IAS Project		X (77-81) Programming	X (64-77) TV & EDVAC				
6 Fuld Hall	X (88-93) IAS & Fuld	X(93-107) Logic and Computers	X(93-107) Godel, Logic, Computers		X Design of Computer				
7 6J6	X(114-29) Choosing people/sites	X(114-29) Brings Engineers			X Building Maniac with Tubes	X (108-14) Cybernetics & N. Wiener			
8 V40	X (130-36) Living Space	X (138-39) JVN and Computing		X (136-141) Organs of a Computer	X (141-53) Rivals and Success				
9 Cyclo-genesis								X Idea of Predicting Weather	
10 Monte Carlo		X JVN and Klari VN & Computer Programs	X JVN and Klari VN & Computer Programs	X Monte Carlo & Stored Program		X Modeling Shock Waves			
11 Ulam's Demons			X Teller and Ulam: Bomb Design			X Teller and Ulam: Bomb Design			
12 Barricelli							X Modeling Evolution		
13 Turing's Cathedral			X Turing' Life	X Turing Machines					
14 Engineer's Dreams	X End of IAS computing	X(266-73) – JVN gets ill and dies			X – End of MANIAC				X(274-81) Where computing has gone
15 Automata			X – AI: JVN and Turing				X Cellular Automata		
16 Mach 9						X Modeling Bombs and Stars			
17 Tale of Big Computer									X Computers Take over the World?
18 39th Step	X –Where they all went				X – Future computers				

Themes by Chapters:

Chapter 1 – 1953 – Barricelli; Bits; kilobytes; Turing, Von Neumann; Three revolutions: Thermonuclear weapons, computers, DNA.

Chapter 2 – Olden Farm -- History of Olden Farm and the Institute

Chapter 3 – Veblen's Circle – Thorstein Veblen; Oswald Veblen; Aberdeen; Norbert Weiner; Flexner; The Institute.

Chapter 4 – Neumann Janos – Von Neumann and the Manhattan Project

Chapter 5 – MANIAC – Television, ENIAC, and MANIAC; Building a Computer; Von Neumann (64-77); Theory of Stored Program Computing; EDVAC Report (77-81); Building a computer at Princeton (81-87)

Chapter 6 – Fuld Hall – Institute (88-93); Von Neumann and Formal Logic and computers and Godel (93-107)

Chapter 7 – 6J6 – Bigelow and Wiener and Bombs (108-114); Von Neumann and Computers and engineers at Princeton (114-129).

Chapter 8 – V40 – Living space for computer builders (130-136); JVN and a memo on computing (138-139); Organs of a computer (136-141); rivals, competition, and success (141-153).

Chapter 9 – Cyclogenesis – Meterology; Richardson; Zworykin; Thompson; Weather prediction; Charney; Smagorinsky

Chapter 10 – Monte Carlo – Klara Dan and Von Neumann; War in Europe; Population Statistics; Stanley Ulam; Monte Carlo and Making Bombs

Chapter 11 – Ulam's Demons – Stanley Ulam and Manhattan Project; Teller; Hydrogen Bomb

Chapter 12 – Barricelli's Universe – Models of Evolution;

Chapter 13 – Turing's Cathedral – Turing; Church; Turing Machine; Artificial Intelligence

Chapter 14 – Engineer's Dreams – Bigelow and Engineering of computer; End of Institute Computing; Von Neumann gets ill and dies (266-273); Thoughts on Computers (274-281)

Chapter 15—Theory of Self-Reproducing Automata – Automata: Barricelli; Turing; von Neumann

Chapter 16 – Mach 9 – Building the bomb; Understanding the Stars—Schwartschild

Chapter 17 – The Tale of the Big Computer – The future of computing; Alfven's tale; The spread of computing and its takeover of the world.

Chapter 18 – The Thirty-Ninth Step – The end of MANIAC; where they all went.