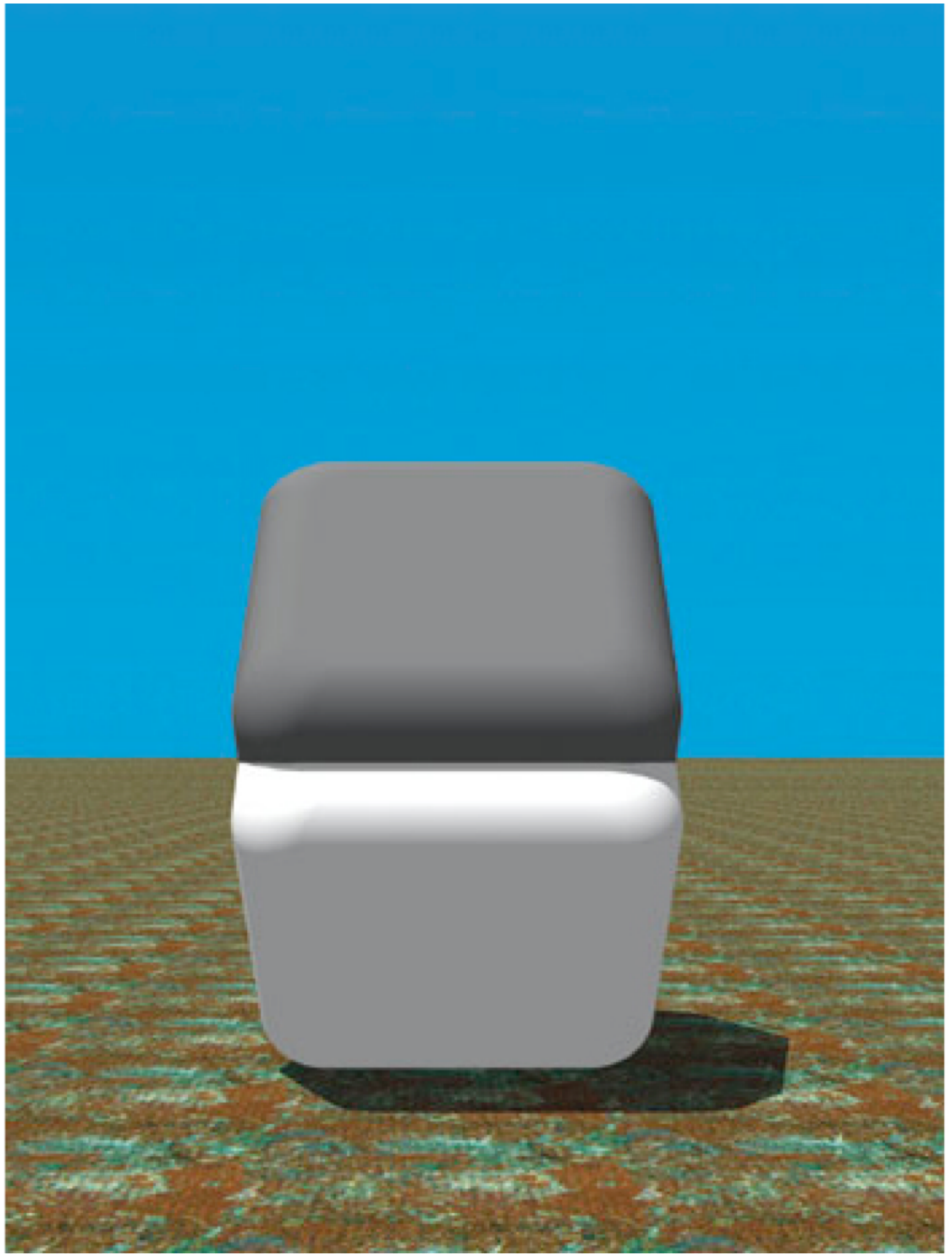
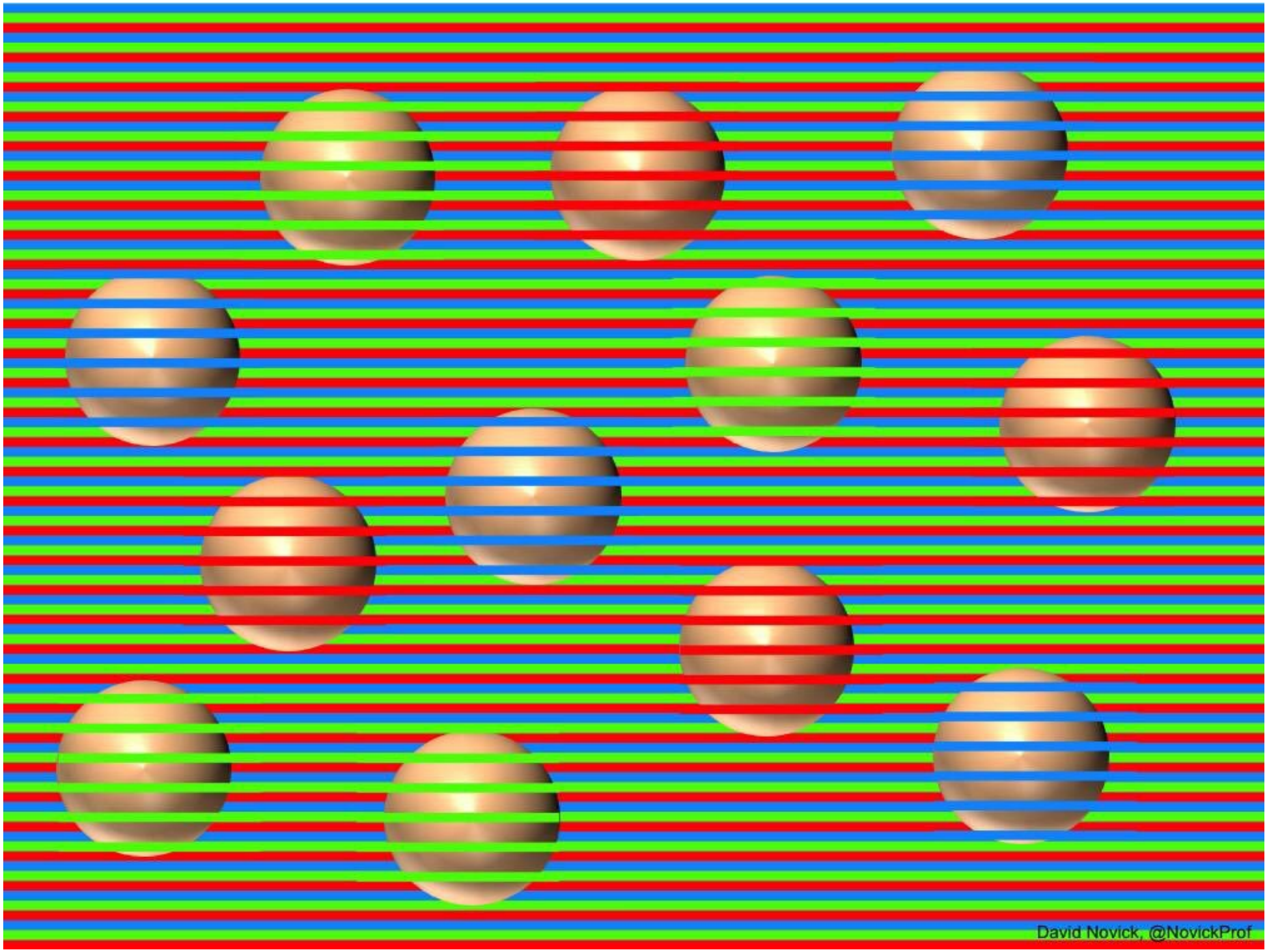



David Novick, @NovickProf

1.1 Epistemology: key concepts

What is Knowledge?

- **Traditional definition**: justified true belief.

What is truth?

- **Correspondence theory**: true claims have a kind of picture-like relationship to the world.
- **Aristotle's being theory**: truth is existence.
- **Deflationary theory**: "P" is true if and only if P.

<u>We will take truth as a primitive!</u>

We distinguish philosophical claims from those indifferent to truth

- Martin Heidegger (1889-1976): claimed that most talk is **idle talk**.
- Harry Frankfurt (1929-): introduce a related concept of **bullshit**.
- Victorian writers called it “humbug.”

Heidegger's Idle Talk

Because [Idle talk] has lost its primary relationship-of-being towards the entity talked about, or else has never achieved such a relationship, it does not communicate in such a way as to let this entity be appropriated in a primordial manner, but communicates rather by following the route of *gossiping* and *passing the word along.* What is said-in-the-talk as such, spreads in wider circles and takes on an authoritative character. Things are so because one says so.

What is Knowledge?

- **Traditional definition**: justified true belief.
- **Revised definition**: properly justified true belief.

What (properly) justifies a belief? Three views (not a complete list!)

- **Foundationalism** (about x): the view that beliefs (about x) are justified if they are consequences of (or otherwise made more likely to be true by) a foundation of indubitable (or at least very likely true) beliefs.
- **Coherentism** (about x): the view that beliefs (about x) are justified if they cohere with one's other beliefs.
- Satisfaction of the **scientific method** (for empirical claims only!)

How do we get knowledge? Three views. (Also not a complete list!)

- **Rationalism** (about x): the view that knowledge (about x) is gained primarily (or sometimes: only) through reason. Rationalists also tend to believe that:
  - We have some important innate beliefs
  - We can accurately judge our own mental states
- **Empiricism** (about x): the view that knowledge (about x) is primarily (or sometimes: only) gained through experience. Empiricists also tend to believe that:
  - We do not have important innate beliefs
  - Our judgments about our own mental states are just as fallible as our judgments about the external world
  - We learn about the world primarily by identifying regularities in our experiences
- **Scientific method**.

Acquisition versus justification

- Empiricism and rationalism are views about how we primarily **acquire** knowledge.
- Coherentism and foundationalism are rival views about how we **justify** a belief and show that it is knowledge.

Be sure to distinguish these *metaphysical* views!

- **Idealism**: the view that the world is made of ideas.
- **Materialism/Physicalism**: the view that the world is made of material or physical things.

Extreme properties that some epistemological theories have

- **Relativism** (about x): having low epistemic standards (about x), so that many (and perhaps even contradictory) statements (about x) are believed to be true.
- **Skepticism** (about x): having high epistemic standards (about x), so that few statements (about x) are believed to be true.

An example of a famous skeptical argument (David Hume (1711-1776))

It appears, then, that [the] idea of a necessary connexion among events arises from a number of similar instances which occur of the constant conjuction of these events…. But there is nothing in a number of instances, different from every single instance, which is supposed to be exactly similar; except only, that after a repetition of similar instances, the mind is carried by habit, upon the appearance of one event, to expect its usual attendant, and to believe that it will exist. This connexion, therefore, which we *feel* in the mind… is the sentiment or impression from which we form the idea of power or necessary connexion…. The first time a man saw the communication of motion by impulse, as by the shock of two billiard balls, he could not pronounce that the one events was *connected:* but only that it was *conjoined* with the other. After he has observed several instances of this nature, he then pronounces them to be *connected*…. When we say, therefore, that one object is connected with another, we mean only that they have acquired a connexion in our thought….

NOTE: one can hold these views in a limited way

- For example, it is consistent to be, all at once:
  - A rationalist about ethics
  - An empiricist about physics
  - An idealist about mathematics
  - A materialist about mind and body
  - A relativist about aesthetics
  - A skeptic about theology….
- That said, many philosophers tend to defend these views in a more global way.

1.2 Foundationalism

We've discussed foundationalism

- **Foundationalism** (about x): the view that beliefs (about x) are justified if they are consequences of (or otherwise made more likely to be true by) a foundation of indubitable or at least very likely true beliefs.

But what is a “consequence”?

- Suppose A and B are groups of one or more sentences.
- We say B is a consequence of A just in case: *necessarily, if all the sentences of A are true, then all the sentences of B are true*.

1.3 Coherentism

An alternative to foundationalism

- **Coherentism** (about x): the view that beliefs (about x) are justified if they cohere with one's other beliefs.

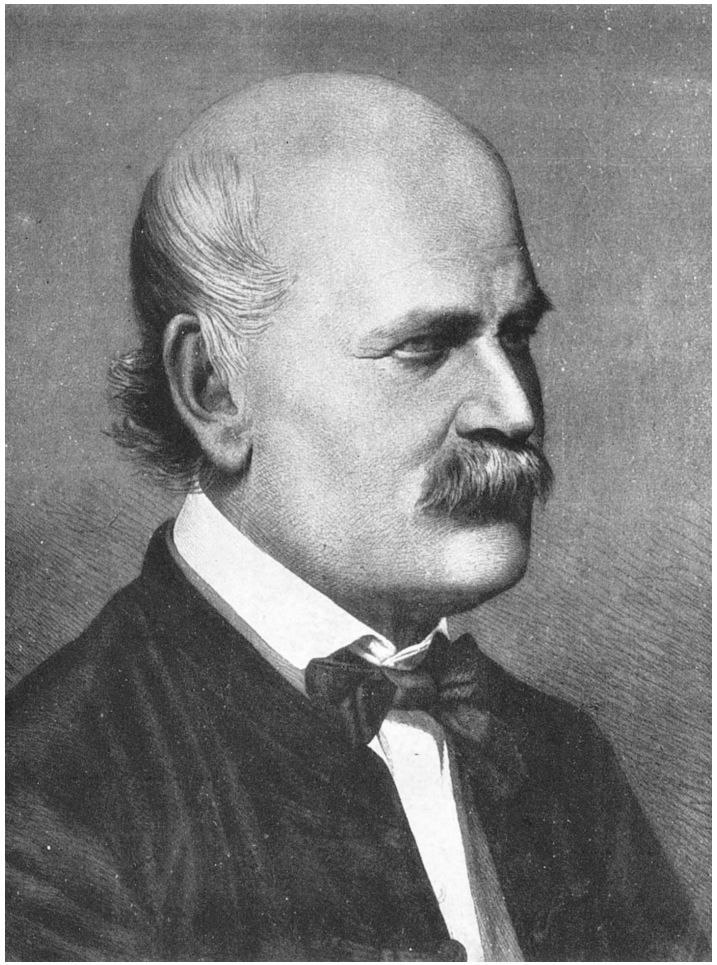
“Coherence” defined (in the strongest way)

- By “contradiction,” we mean two sentences that cannot both be true. For example: *Tom is now in Paris* and *Tom is not now in Paris.* There are also single sentences that are contradictory (these are sentences that cannot be true): *Tom is and is not now in Paris.*
- A set of sentences A is coherent if there is no contradiction in A (or in the consequences of A).
- Two sets of sentences A and B are coherent with each other if there is no sentence in A (or consequence of the sentences in A) that contradicts a sentence in B (or consequence of sentences in B), and vice versa.
- (NOTE: defined in this way, it is unclear what it means to say something is “more coherent” or “less coherent.” Perhaps it means it is harder or easier to identify a contradiction, or that contradictions are less or more likely to arise in a way that matters to your work.)

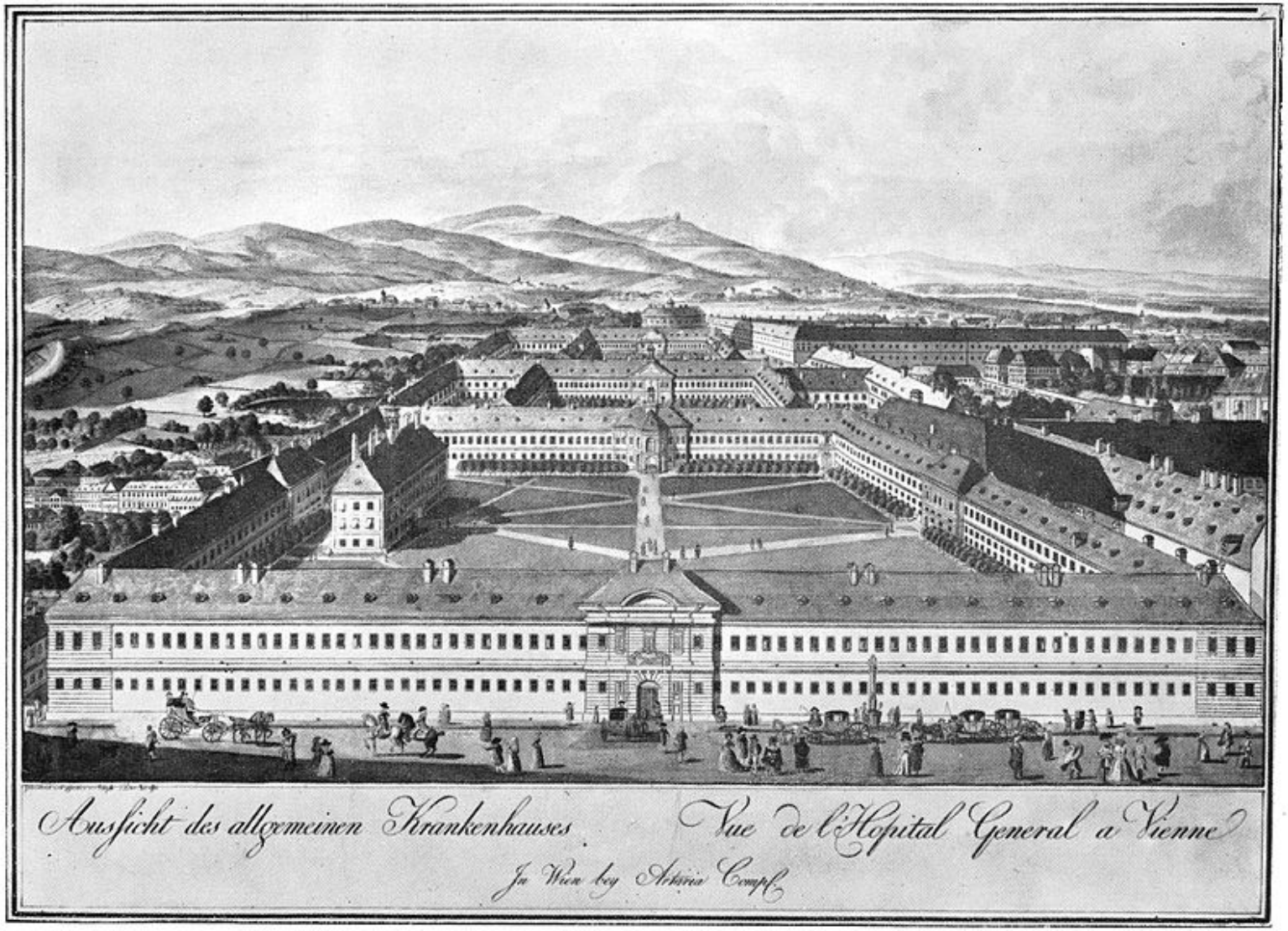
1.4 Scientific method

An example: Ignaz Semmelweiss

- 1818-1865
- Studied deaths in the Vienna General Hospital from 1844-1848



Vienna General Hospital



The data

- Deaths of mothers in childbirth in the First Division:
  - 1844: 8.2%
  - 1845: 6.8%
  - 1846: 11.4%
- Deaths of mothers in childbirth in the Second Division:
  - 1844: 2.3%
  - 1845: 2.0%
  - 1846: 2.7%

Source: Carl Hempel.

The Hypotheses

- Atmospheric cosmic telluric changes
- Overcrowding
- Rough examinations
- The frightening priest’s bell
- Laying on their backs (not their sides)
- The autopsies

The Scientific Method (very simplified)

- Formulate a hypothesis.
- Identify a prediction: this is a particular testable consequence of the hypothesis.
- Use a test to observe if this prediction comes true. (The test must be such that you can share the results with others.)
- Reject the hypothesis if the prediction proves false, and continue to test the hypothesis if the prediction proves true.
- If more than one hypothesis passes this method (that is, if you have two different hypotheses neither of which has been refuted), chose (in order of preference):
  - The one with the most predictive power
  - The one that is most productive
  - The one most coherent with your other theories
  - The simplest one

NOTE: No scientific theory is necessarily true. Each scientific theory must be *falsifiable.* Falsifiability is captured in the fact that our predictions that are a consequence of our hypothesis must be such that it is possible to show them false.

Although a scientific theory is never necessarily true, what we can say is that our scientific theories are tested and have been shown to be our *best* explanations.

We use our hypothesis **H** to make a testable prediction **P**

- Given our hypothesis **H**, our prediction **P** must be such that it makes the following sentence true:

  *If our hypothesis **H** is true, then our prediction **P** is true.*

- From this, we know:
  - If the prediction **P** proves false, then logic tells us the hypothesis **H** is false.
  - If the prediction **P** proves true, then logic tells us the hypothesis **H** <u>may</u> be true.

Another example: Tiktaalik

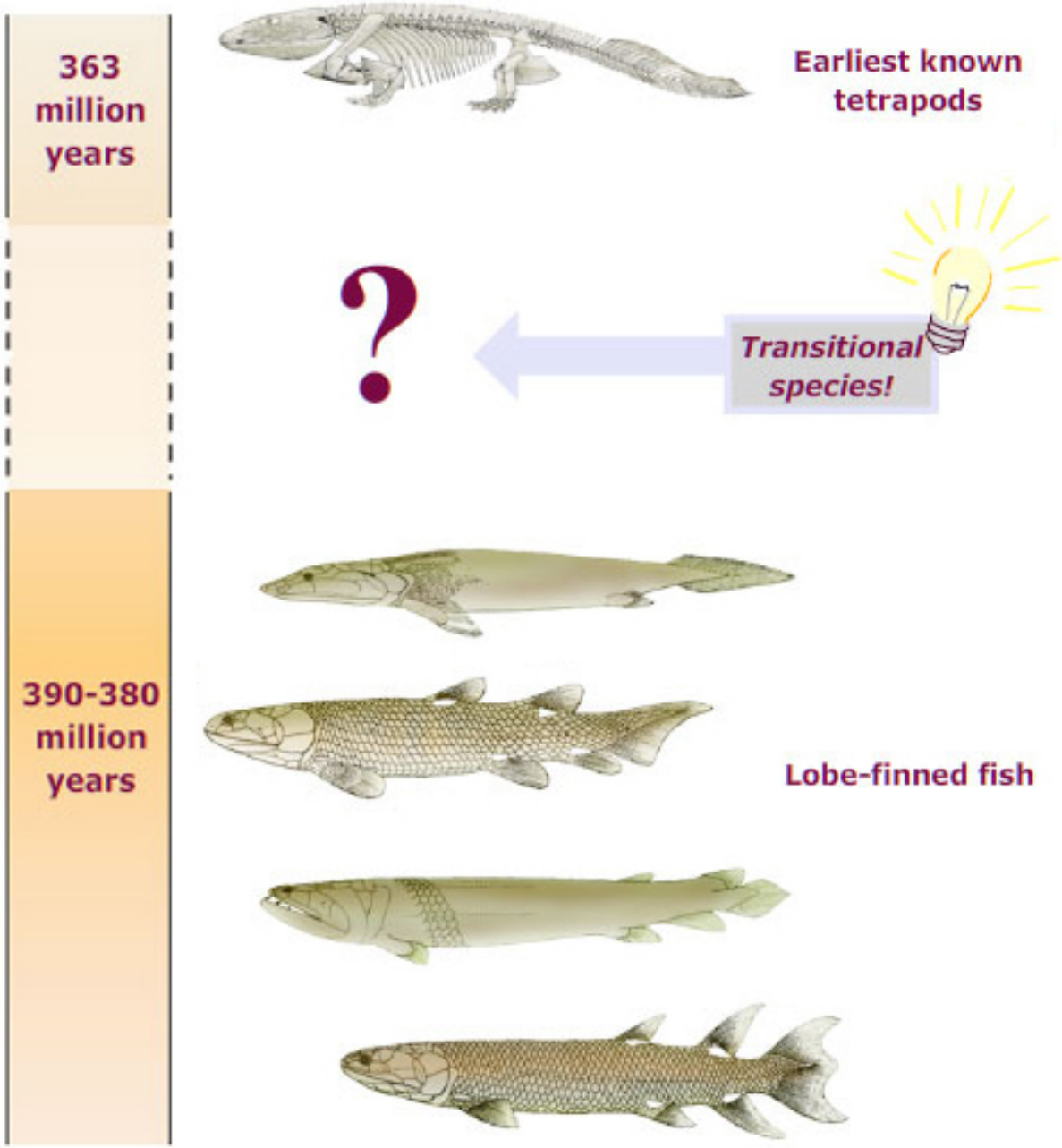

363 million years
Earliest known tetrapods
?
Transitional species!
390-380 million years
Lobe-finned fish

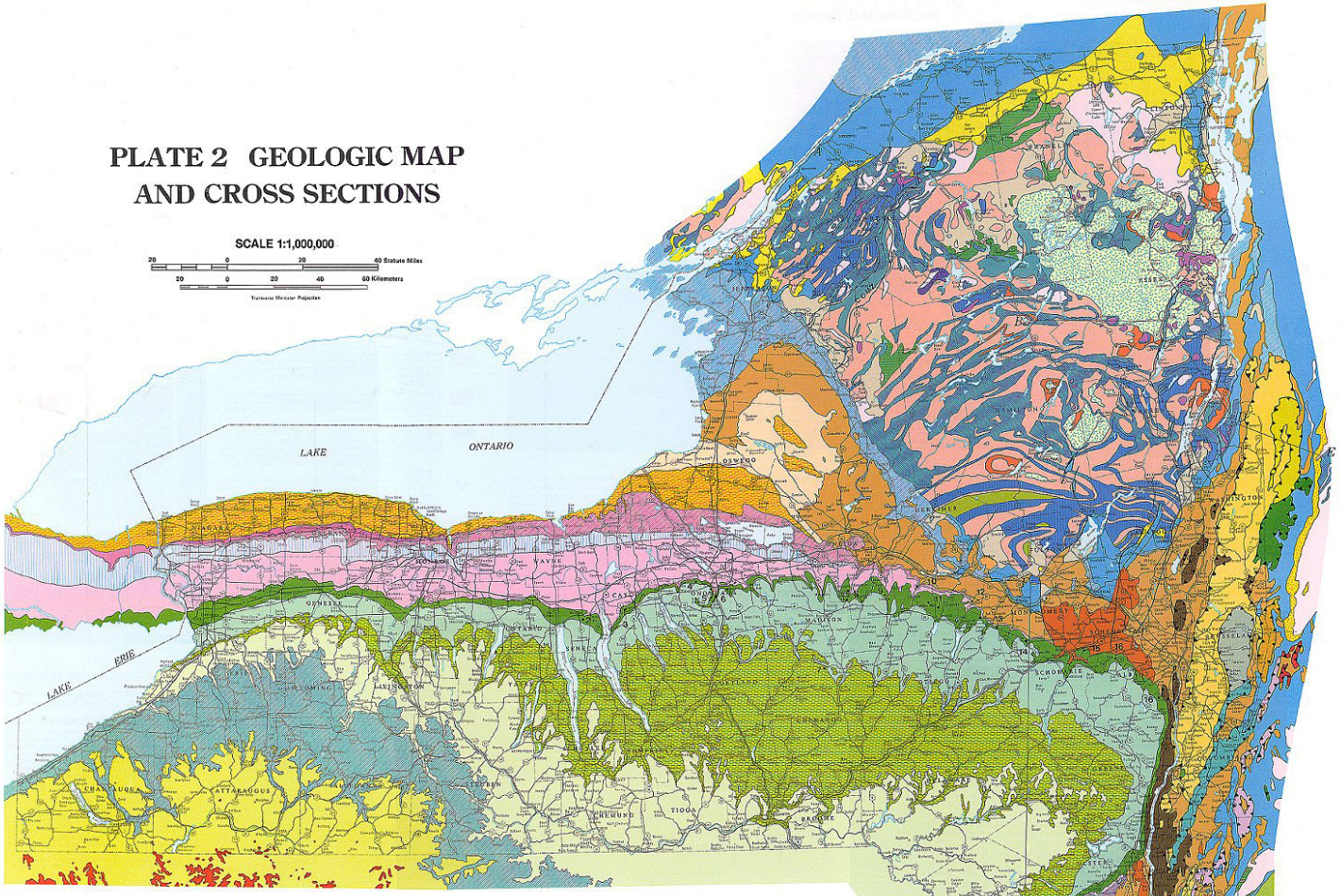
PLATE 2 GEOLOGIC MAP AND CROSS SECTIONS

SCALE 1:1,000,000

20 0 20 40 Statute Miles

20 0 20 40 60 Kilometers

Transverse Mercator Projection



BEDROCK GEOLOGY OF NEW YORK

The crust of the earth is solid rock, tens of kilometers thick, made up of individual rock bodies that vary in size, shape, orientation, composition, color, and texture. Together they make up the bedrock, which is present everywhere, although commonly masked by surficial deposits.

The bedrock geologic map gives a vertical view of the pattern made by the exposed edges and surfaces of the rock bodies that crop out in the State. It is, however, only a two-dimensional view of three-dimensional rock bodies. The cross sections below the map show samples of the third dimension as inferred from the surface configuration of rock bodies and other information that may be available from drill holes or geophysical measurements.

Map patterns result from the intersection of topography and individual rock bodies. Most rock bodies are originally tabular and horizontal, but deformation changes their orientation and shape by tilting, folding, crumpling, and breaking. Map patterns can tell us much about the three-dimensional configuration of bedrock in different regions. For example, the rock bodies in western New York are layers of sedimentary rock, of greatly different thicknesses, that are tilted down to the south less than 1 degree. The broad bands on the map in that area are the patterns made by stacked layers that have been beveled at a low angle by erosion. (Visualize a layer cake sliced at a low angle instead of the usual vertical.) Widths of outcrop bands are controlled by the thicknesses of individual map units, the topography, and the low dip. Stream valleys account for the jagged details in the pattern. Steeply dipping faults are omitted from the geologic map except where they separate rock bodies of greatly different ages. This avoids unnecessary congestion on the map, especially within the Adirondacks where such faults abound.

In the Adirondack Mountains the map pattern shows once-tabular rock bodies now swept into broad folds. This deformed rock pattern is typical of highly metamorphosed "basement" rock. One can easily visualize this rock pattern continuing in the basement as it passes beneath the blanket of sedimentary strata that surrounds the Adirondacks. The pattern of small blocks along the eastern border of the Adirondacks results from faulting that dropped crustal blocks down into a giant staircase.

The Taconic Mountains east of the Hudson River Valley are huge slices of crust that were thrust into that area from the east. The heavy toothed lines show the edges of these thrust sheets. The earth's crust in this region was "telescoped" when a volcanic island arc collided with the edge of the continent, causing the Taconian orogeny. This collision compressed the layered rock and sediment of the intervening sea, thrusting them westward onto the continent as huge, stacked slices. The slices, which generally dipped east in a shingled arrangement, were contorted considerably in the process. When completed, the stack extended from New England past the western edge of the Hudson Valley. In the Catskill Mountains, the western edge of this transported rock remains buried beneath Devonian rock. Erosion has reduced the original thrust sheets to patches, exposing windows to the rock beneath.

The legend on the facing page shows the formations and rock types in each map unit. The legend has two major parts based on divisions of geologic time, Paleozoic and Paleozoic-Mesozoic. Highly deformed Proterozoic rock bodies of the basement are buried beneath younger Paleozoic rock in most of the State, but crop out in the Adirondacks and the Hudson Highlands. Southeast of the Highlands, basement relationships become more complex as one approaches the deformed and metamorphosed east zone of the ancestral Appalachian Mountains (see cross section FGH beneath the geologic map). The Paleozoic-Mesozoic part of the legend applies to the wide expanse of sedimentary rock formations that blanket the State west of the Hudson River and south of the Adirondacks. The black areas with yellow tint represent gaps in the rock record—geologic times not recorded by rock because of erosion or non-deposition.

Surficial material is ignored on generalized bedrock geologic maps, but it is shown here in several areas of the Adirondacks and over all of Long Island, where it is so thick that it masks all clues to the bedrock geology.

SURFICIAL GEOLOGY OF NEW YORK

Bedrock generally is covered by a skin of soil and other loose material, especially in regions with humid climates. This cover material results as weathering breaks down the surface rock. The loose materials may remain in place or be eroded, transported, and deposited by water, wind, or glacial ice. In 90 percent of New York State, bedrock is buried by surficial deposits that are more than one meter thick. Most of these deposits were left by a continental glacier—an ice sheet that was perhaps 2 km thick.

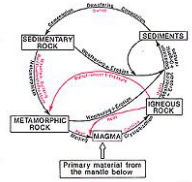
Till is the most abundant glacial deposit. It is an unsorted mixture of mud, sand, gravel, cobbles, and boulders that the glacier spread over the countryside. Till can be up to 50 meters thick. It is generally thickest in valleys and thinnest over highlands. *Moraines* are elongate ridges or strings of hills that formed at the edge of the glacier and are composed of sand, gravel, or till. The Ronkonkoma and Harbor Hill moraines on Long Island dominate that landscape. The Valley Heads moraine dams the south ends of the Finger Lakes. *Glacial lake beds* are broad horizontal layers of mud (deep water) and sand (shore zone) that were deposited in lakes that formed in front of the glacier as the ice melted. *Outwash* is sand and gravel deposited by meltwater streams that flowed from the front of the glacier. All of these kinds of deposits have a wide range of thicknesses. In places, they may be piled one on top of the other.

ROCK FORMING PROCESSES

The earth's crust is of two major types, continental (35 km thick) and oceanic (10 km thick). Continental crust is less dense than oceanic crust, which causes the continents to stand higher than the ocean floors.

Three major classes of rock make up the earth's crust: igneous, metamorphic, and sedimentary. Continental crust is divided into crystalline "basement" rock and overlying layers of sedimentary rock or layered volcanic rock. The basement is a complex of metamorphic and igneous rock bodies that were generated in the roots of mountains. These record long, repeated cycles of subsvergence; burial by sedimentation; mountain-building with metamorphism, igneous intrusion, and volcanism; and uplift and erosion. Sedimentary rock blankets the basement over three quarters of the earth's continental area. This blanket ranges in thickness from a feather edge to more than 14 km. It includes many individual layers that began as widespread horizontal accumulations of sediment such as sand and mud. As sediment piles up, the lower part is compressed under the load. Water is squeezed out of the pores, and eventually the sediment is cemented into rock. These processes and cycles are summarized by the Rock Cycle diagram below.

ROCK CYCLE in EARTH'S CRUST

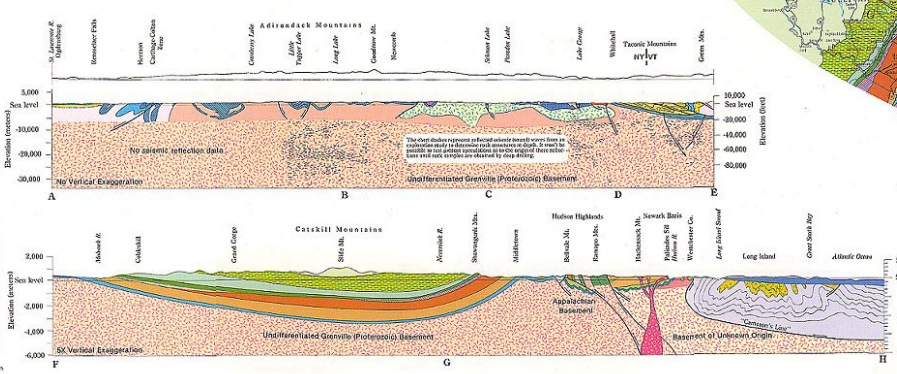


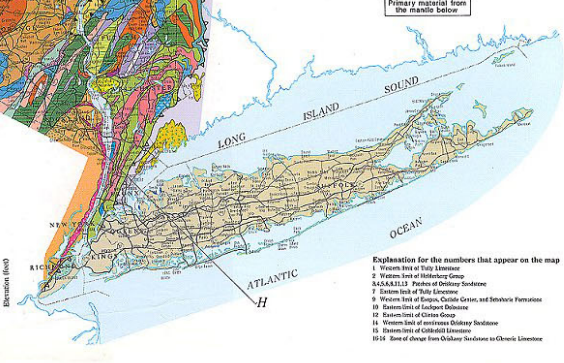
GEOLOGIC CROSS SECTIONS

Geologic cross sections show hypothetical vertical slices through the earth's crust. These two cross sections permit the reader to compare the geology of three sharply different types of mountains, the domed Adirondacks, the residual Catskills, and the folded and thrusted Appalachians.

Cross section ABCDE (located on the geologic map) extends from the St. Lawrence Lowlands, across the Adirondack Mountains, and into Vermont. It shows the surface of the earth in profile and the inferred configuration of the rock bodies below the surface. Notice how subdued the surface profile appears when drawn at true scale. The profile above the cross section, drawn with a 5-fold vertical exaggeration, provides a more familiar (although distorted) picture of the topographic relief. The areas shown in shades of blue represent a variety of metamorphosed sedimentary rocks. These rocks were originally deposited in a shallow sea as horizontal layers, but have deformed into tight folds during the Grenville orogeny about 1 billion years ago. The Taconic Mountains and Green Mountains east of the Adirondacks are part of the Appalachian Mountain chain. Bedrock there was thrust westward tens of kilometers along faults during the Taconian orogeny about 450 million years ago. Several faults not shown on the geologic map are shown in the cross section as examples of their character and importance.

Geologic cross section FGH extends southward from the Mohawk River to the Catskill Mountains, then southeast across Long Island. In order to show the thin rock units, it was necessary to use a 5-fold vertical exaggeration for this cross section. The use of vertical exaggeration implies not only topography and rock thickness, but the tilt of the rock layers as well: the strata between F and G are actually nearly horizontal! At the Shawangunk Mountains, near the western edge of the Appalachian fold belt, they are slightly upturned. Proceeding eastward Appalachian deformation increases. The strata of Hellgate Mountain have been folded into a large syncline, and faults have dropped this structure down even more. Farther east, these same Paleozoic rock units become sufficiently deformed and metamorphosed to constitute "Appalachian Basement." This basement is thrust over overlodden by the "Grenville Basement" of the Hudson Highlands, but continues to the east beneath the downdropped Newark Basin. It comes to the surface east of the Palisades diabase sill and Hudson River where, along with Proterozoic basement, it makes up the borough of Westchester County and the New York City area. The terrane east of the "Cameron's Line" fault was transported westward great distances as a volcanic island arc until it collided with the North American continent causing the Taconian orogeny. Beneath the New York City, the dangle eroded island arc terrane forms the basement beneath Cretaceous and overlying Pleistocene deposits. The small fault basin beneath the Cretaceous deposits is of the same age and character as the Newark Basin.

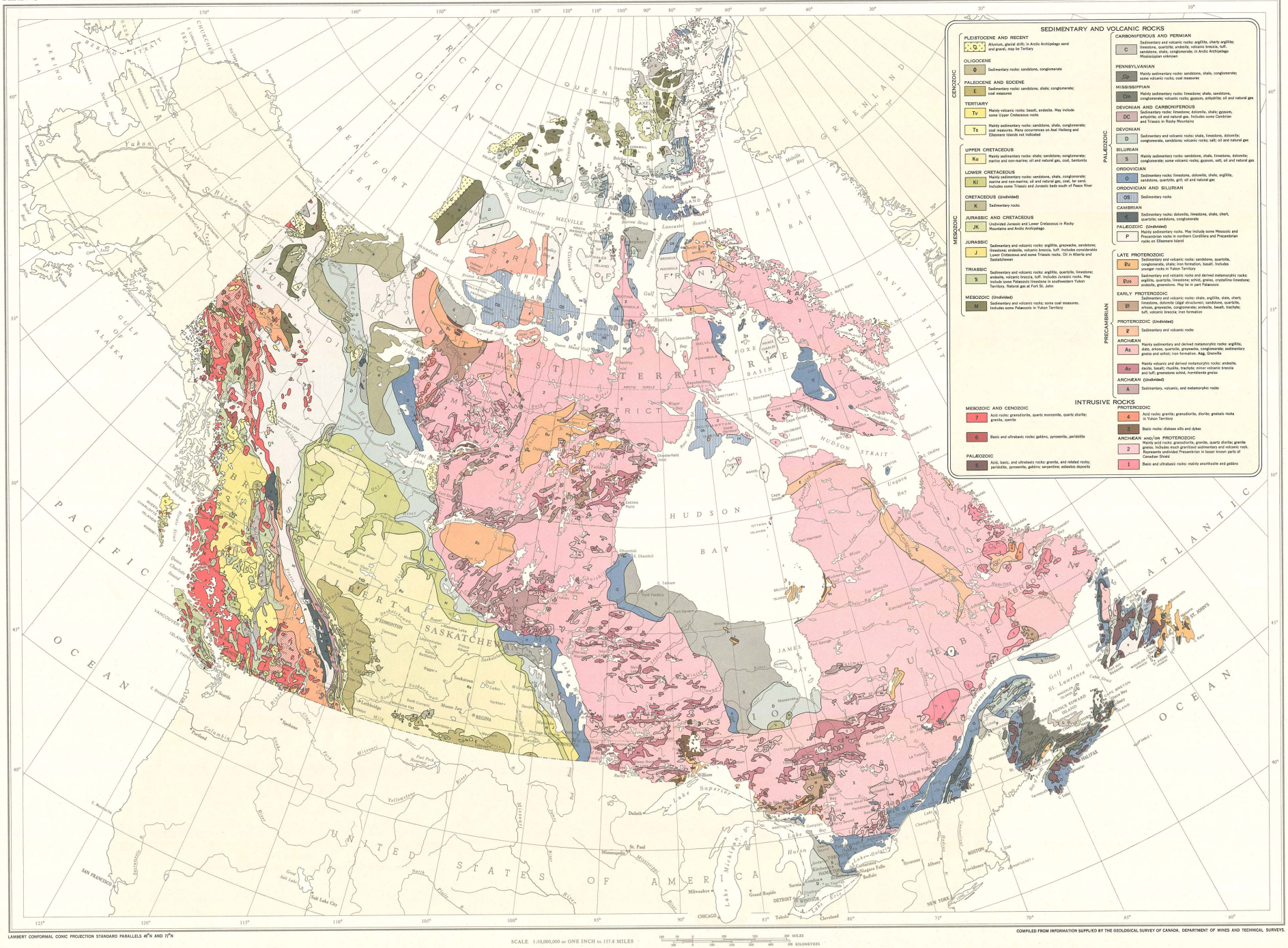




Explanation for the numbers that appear on the map

1 Western limit of Tully Limestone
2 Western limit of Helderberg Group
3,4,5,6,8,11,13 Patches of Oriskany Sandstone
7 Eastern limit of Tully Limestone
9 Western limit of Esopus, Cornish Corner, and Schoharie Formations
10 Eastern limit of Lockport Dolomite
12 Eastern limit of Clinton Group
14 Western limit of continuous Oriskany Sandstone
15 Eastern limit of Catskill Limestone
16-16 Zone of change from Oriskany Sandstone to Glenerie Limestone

BEDROCK GEOLOGY



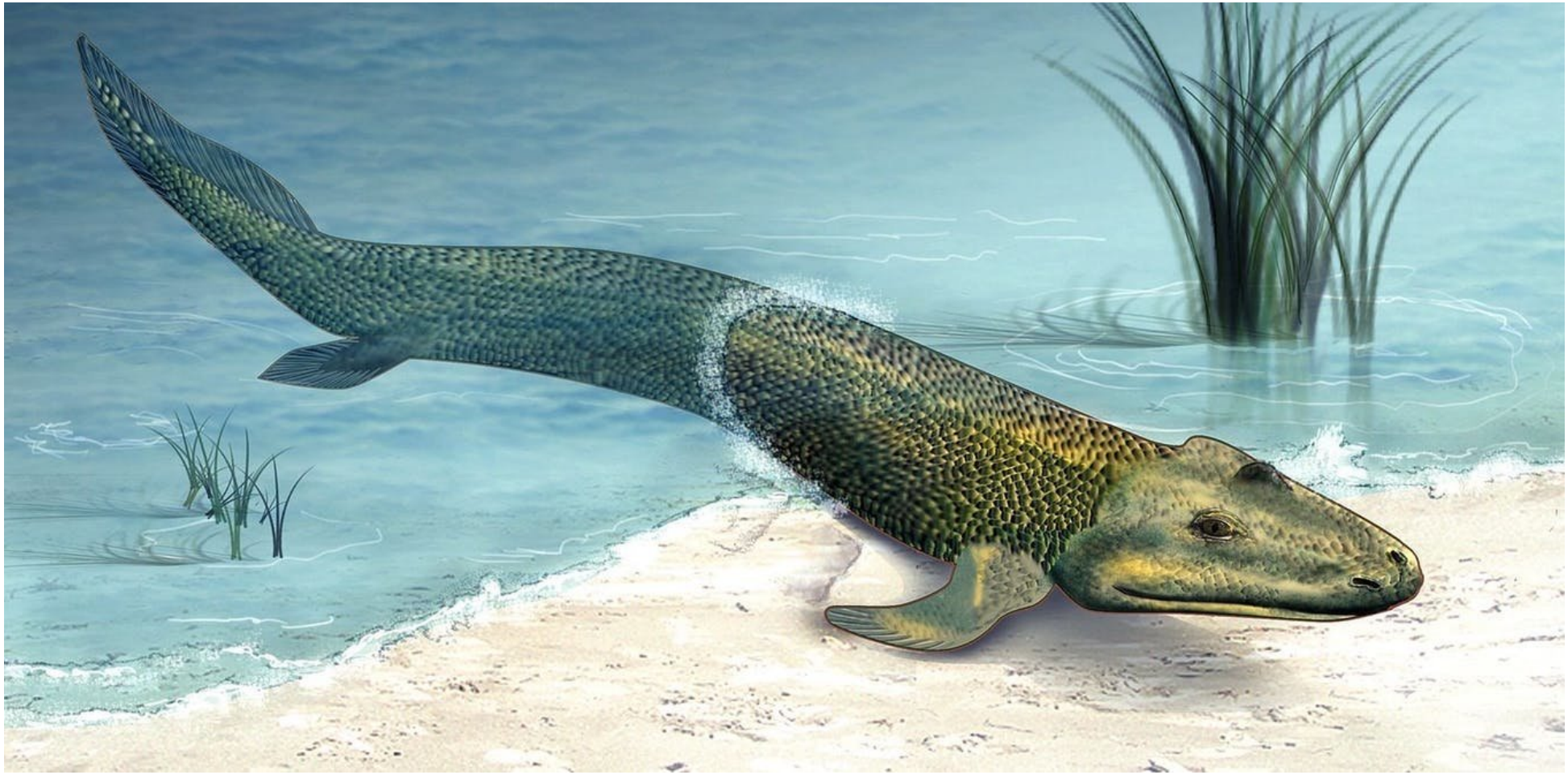
LAMBERT CONFORMAL CONIC PROJECTION STANDARD PARALLELS 49°N AND 77°N

SCALE 1:10,000,000 or ONE INCH to 157.8 MILES

100 50 0 100 200 300 MILES
200 100 0 100 200 300 400 500 KILOMETRES

COMPILED FROM INFORMATION SUPPLIED BY THE GEOLOGICAL SURVEY OF CANADA, DEPARTMENT OF MINES AND TECHNICAL SURVEYS.

Tiktaalik



1.4 Other methods?

Mysteries remain.
For example, math.

- We are not sure about how we learn creative new steps in mathematical methods.
- Maybe rationalism is true of mathematics?
- Or something else?

But! Although we don't know how we understand the most advanced methods of mathematics and logic, we consistently get reliable results from math and logic. So the mystery does no harm.

Wait! Do philosophers agree on anything?

- Most philosophers agree that:
  - Scientific method is a reliable guide to learning about many physical phenomena
  - Mathematical results are reliable
  - Logical methods are reliable.
- (There is some disagreement about what science, math, and logic *are,* however.)
- Consider the consequences of this consensus: epistemology is most important when we either
  - ask about things that science or math cannot alone explain, or
  - ask about what science and math and logic are and why they work.