THREE THINGS: ECLIPSED, KILLER ROBOTS, BACK TO THE SALT MINES [UPDATED]

Eclipse stuff with killer robots and salt mines to come. This is an open thread.

OTHER PRIORITIES: ANOTHER LAUNCH TODAY – BLUE ORIGIN REUSABLE ROCKET

Hurry, we're less than three minutes from launch, all systems go. I'll add more remarks in a moment.

11:20 a.m. EDT – Wow. What a picture-perfect launch and landing. This is the most excitement out of West Texas since some lousy bird hunter shot his friend in the face a few years back. Today's mission by Blue Origin, an aerospace company founded by Amazon CEO Jeff Bezos, had several objectives. The reusable rocket's fourth mission included testing of backup and safety systems intended for future manned flights as well as multiple scientific project payloads. At least one project required the microgravity conditions (video) this mission would realize as the ship approached, reached, and left apogee at 331,501 feet (roughly shy of 63 miles above earth).

I've replaced the live feed of the mission with a video summary of the same New Shepherd rocket's third flight from April this year. Compare and contrast with Elon Musk's SpaceX's

recent reusable rocket launches; I am completely in awe of SpaceX's attempts to stick a landing repeatedly on a puny drone raft at sea. (Video embedded here is from SpaceX launch last Wednesday carrying Eutelsat/ABS telecommunications satellites.)

If we have to endure gross inequality and a siphoning plutocracy, this space race is the kind of crazy oligarchs' spending I love to see. Granted, Bezos is probably checking out future warehousing for Amazon facilities in space, crewed by robots — there's no rent in space, right? But the opportunities for aerospace development and accessibility to the public have increased greatly with these two companies working fast and hard on this implicit competition. They also offer opportunities for us to save costs on government-funded missions — SpaceX has already won contracts formerly awarded to companies with an oligopolistic hold on launches.

I still want NASA to do all this and more as well; space shouldn't be the domain of corporations after all. But if NASA has to work with fewer resources thanks to anti-science GOP-led Congress, at least they have a much larger hiring pool of experts to drawn from when they look for aerospace folks to add to their team, thanks to Blue Origin and SpaceX.

Explaining his refusal to serve in the military, that aforementioned sloppy hunter who shot his friend in the face said he had other priorities. It's amazing in contrast what other rich guys do with their other priorities.

Jeff Bezos had one helluva Father's Day already. Hope yours is just as exciting.

AS DISNEYLAND MEASLES OUTBREAK RAGES IN CALIFORNIA, PAKISTANI FATHER ARRESTED AFTER UNVACCINATED SON CONTRACTS POLIO

There is very interesting news out of Pakistan today that the father of a child who has developed polio has been arrested because he refused to allow his son to be vaccinated:

> After a polio case was detected here on Thursday, the Kohat administration arrested the father of the affected child because he had refused to get his child vaccinated against polio when vaccinators visited his home. Two health supervisors and a patwari have also been taken into custody for showing negligence in performing their duty.
>
> Three-year-old Mohammad is the second victim of polio in Dhodha area of Kohat district this year.
>
> Deputy Commissioner of Kohat Riaz Khan Mehsud told Dawn on telephone that he issued orders for arrest after an inquiry revealed that the father of the affected child, Mullah Mohammad Yousuf, had not allowed vaccinators to give polio drops to his son.

But Yousuf is not the only parent who has been arrested:

> He said 56 people had so far been arrested this year for refusing to get their children vaccinated against polio.

> Also on Thursday, two men were arrested in Kohat for not allowing vaccinators to give polio drops to their children. They were identified as Amir Khan and Hassan Khan.

Islamic extremist groups in Pakistan agitate against polio vaccines, spreading conspiracy theories that the vaccines are Western attempts to kill or dominate Muslims. They even attack health workers and in 2014, those attacks killed more people administering vaccines than the disease itself killed.

But of course, in a civilized country like the United States, there couldn't be misguided attempts to prevent vaccination despite the solid scientific basis of the public health benefits of vaccines, could there? Sadly, the mass delusion that has led far too many parents to leave their children unvaccinated due to unfounded fears of autism is having the very predictable result of outbreaks of viral diseases previously under control. Here's the latest on the current outbreak of measles that epidemiologists have traced to Disneyland. Unfortunately, we are learning that because of the reckless behavior of not vaccinating children, even those who have been vaccinated are now developing the disease because of the increased exposure from the outbreak:

> As the measles outbreak that started at Disneyland grew to at least 70 cases Wednesday, much of the attention has focused on how the vast majority of patients were not vaccinated for the highly contagious disease.
>
> But some medical experts also have expressed concern about the five patients who contracted measles despite being fully vaccinated.
>
> Their cases point to a lesser-known aspect of the measles vaccine: That even those who get the shots have a small

> risk of getting sick, especially older people who were immunized in the 1960s, ’70s and ’80s.

In 1989, the vaccination program for measles was changed from one dose to two, and that had an effect on how frequently vaccinated patients got the disease:

> There’s a 5% chance of vaccine failure in people who have had only one dose of measles vaccine, and a less than 1% chance in people with both doses, experts said.

But the expanding pool of unvaccinated people means much more exposure for those who have been vaccinated. Here are the numbers from the current outbreak:

> The measles cases spread at Disneyland a week before Christmas. Experts have said the theme park was a perfect incubator because it attracts visitors from all over the world, such as places in Europe and Asia where measles is still a large problem.
>
> Since then, the disease has continued to spread, mostly through people who were not vaccinated. Health officials have immunization records of 43 measles patients; 37 were unimmunized, one had only one shot, and five were fully immunized.

In the US, those who choose to leave their children unvaccinated are acting out of a misinformed belief that vaccines lead to autism. Sadly, science has clearly debunked that idea, so the parents making that choice are just as illogical as the ones in Pakistan giving in to Islamic extremists.

A good layperson discussion of the science of autism and vaccines can be found here. Perhaps

the most authoritative study on vaccines and autism was this one by the Institute of Medicine, published in 2004, which stated clearly:

> This eighth and final report of the Immunization Safety Review Committee examines the hypothesis that vaccines, specifically the measles-mumps-rubella (MMR) vaccine and thimerosal-containing vaccines, are causally associated with autism. The committee reviewed the extant published and unpublished epidemiological studies regarding causality and studies of potential biologic mechanisms by which these immunizations might cause autism. The committee concludes that the body of epidemiological evidence favors rejection of a causal relationship between the MMR vaccine and autism. The committee also concludes that the body of epidemiological evidence favors rejection of a causal relationship between thimerosal-containing vaccines and autism. The committee further finds that potential biological mechanisms for vaccine-induced autism that have been generated to date are theoretical only.

A strong reason that the data don’t support a causal relationship between vaccines and autism is that there is instead a strong genetic component related to developing autism:

> Scientists have discovered that one of the most common genetic alterations in autism – deletion of a 27-gene cluster on chromosome 16 – causes autism-like features. By generating mouse models of autism using a technique known as chromosome engineering, researchers provide the first functional evidence that inheriting fewer copies of these genes leads to features resembling those used to diagnose children with autism.

In that study, scientists found that by reproducing the chromosomal change that is found most commonly in autism patients (autism spectrum should be considered a group of related diseases which can have differing causes) in mice, behavior very similar to autism was seen:

> “Mice with the deletion acted completely different from normal mice,” explains Guy Horev, a Postdoctoral Fellow in the Mills laboratory and first author of the study. These mice had a number of behaviors characteristic of autism: hyperactivity, difficulty adapting to a new environment, sleeping deficits, and restricted, repetitive behaviors.

As if that’s not enough, consider this study from Japan, where it was found that in an area where the MMR vaccine was discontinued, autism rates did not go down:

> The MMR vaccination rate in the city of Yokohama declined significantly in the birth cohorts of years 1988 through 1992, and not a single vaccination was administered in 1993 or thereafter. In contrast, cumulative incidence of ASD up to age seven increased significantly in the birth cohorts of years 1988 through 1996 and most notably rose dramatically beginning with the birth cohort of 1993.
>
> The significance of this finding is that MMR vaccination is most unlikely to be a main cause of ASD, that it cannot explain the rise over time in the incidence of ASD, and that withdrawal of MMR in countries where it is still being used cannot be expected to lead to a reduction in the incidence of ASD.

So, as global autism (ASD = autism spectrum disease) rates were increasing in the late 1980’s through mid 1990’s, that increase was not affected in Yokohama by the termination of the

measles vaccine.

Finally, a more detailed study published in August 2013 (pdf) found that there was no correlation between autism and the number of vaccines administered or the total number of antigens in vaccines that a child received.

Perhaps the Pakistani practice of arresting parents who refuse to vaccinate their children is something to be considered here in the US. The decision to leave a child unvaccinated creates an unacceptable risk for that child. And as we are seeing in the current outbreak, the growing pool of unvaccinated people means that individual cases of the disease are capable of growing into an outbreak large enough to infect even properly vaccinated patients. The LA Times article linked above notes that about one fourth of the infected California patients required hospitalization, so their disease was relatively severe. Irresponsible parents who choose not to vaccinate endanger their children and all of those with whom they interact. If reason won't work with them, it's time to determine what will bring them to their senses.

EBOLA OUTBREAK FINALLY RECEDING IN SIERRA LEONE; CDC MODELING WAS INCREDIBLY ACCURATE

Back in late September, just a week before Ebola panic hit a peak in the US when a patient in Dallas was diagnosed with the disease, the CDC produced a remarkable study in which they modeled the expected number of Ebola cases both with and without intervention. That study

received a huge amount of press coverage, primarily because the model predicted that without intervention by public health authorities, as many as 1.4 million people could be infected. By contrast, with a program of isolating infected patients and educating survivors on proper burial techniques, the model showed that the outbreak would be much less widespread. The modeling projected cases through yesterday's date, January 20.

Less reported in the media at the time was the projected number of cases under the scenario of intervention. The model predicted an actual number of cases between 25,000 and 30,000 by this week and a reported number of cases of nearly 10,000. Here are the two projections placed alongside one another:

The latest data from WHO indicate just over 21,000 cases as of January 11. That is a remarkable achievement by the team that developed the model. The observed actual number of reported cases fell squarely within the range predicted by the model. With the influx of health professionals to the region to provide care for infected patients, it seems likely to me that the correction factor applied in the CDC model to correct from the reported number of cases to the actual number would be very different now, so that the reported number and actual number would be much closer to one another, making the prediction even more accurate.

Last time I posted on progress in stopping the spread of the virus, we saw that the rate of appearance of new cases was dropping rapidly in Liberia but was still accelerating in Sierra Leone. The good news is that the improved practices have finally been implemented sufficiently in Sierra Leone that the rate is now dropping there. Here are the plots of weekly new cases in the two countries from the latest WHO Situation Report:

Although the battle is not yet over, all indications are that the outbreak is well past

the worst phase and should end soon. Considering how closely the CDC model predicted the eventual size of the outbreak with the control measures that were implemented, it seems safe to say that the world would have witnessed a truly horrific level of spread of the virus had improved safety measures not been implemented. As of the January 14 WHO Situation Report, a total of 825 health care workers have been infected, with 493 of them dying. Without their sacrifices, many more would have been lost.

GAO ANALYSIS HIGHLIGHTS LAB SAMPLES EXCLUDED IN SLOPPY FBI ANTHRAX INVESTIGATION

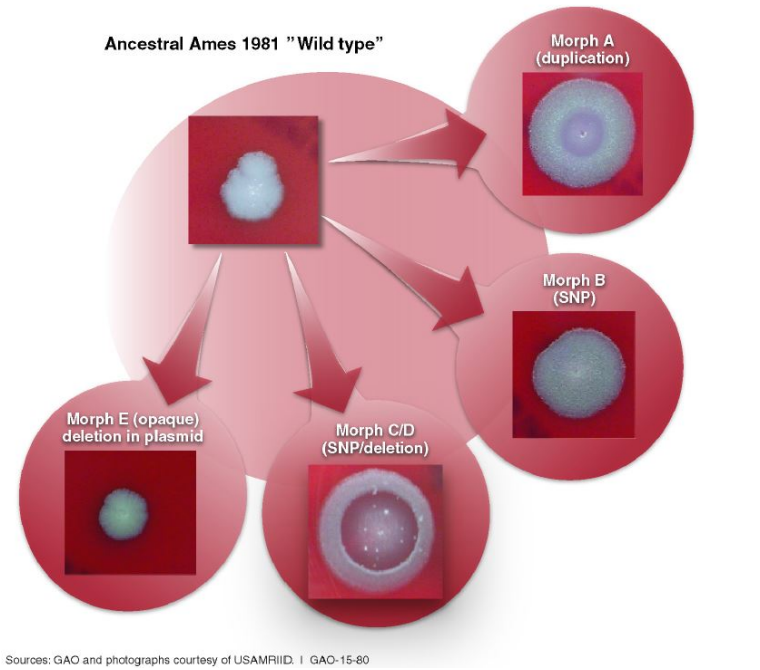
As the last Friday before Christmas, late yesterday afternoon was the most obvious Friday news dump hour of the year, and the government didn't disappoint. The Government Accountability Office released the results of a twenty-three month long study of the genetic analysis that was used to tie the material found in the anthrax attacks of 2001 to the laboratory of Bruce Ivins, whom the FBI concluded (pdf) was solely responsible for the attacks. The FBI's conclusion is highly suspect for many reasons. On the science side, it is very unlikely that Ivins could have produced all of the attack material on his own and the detailed chemistry of the attack spores suggests that highly sophisticated materials and techniques unavailable to Ivins likely were used to prepare the attack material. Regarding that second point, note that even William Broad refers indirectly to the chemistry concerns in his New York Times article on the GAO report:

> To the regret of independent scientists, the report made no mention of an issue beyond genetics: whether the spores displayed signs of advanced manufacturing. They have pointed to distinctive chemicals found in the dried anthrax spores that they say contradict F.B.I. claims that the germs were unsophisticated.
>
> Evidence of special coatings, they say, suggests that Dr. Ivins had help in obtaining his germ weapons or was innocent.

The GAO study was undertaken, in part, because of questions raised by the National Academies study released in 2011 and with special prompting by Representative Rush Holt, from whose district the letters likely were mailed. The GAO study focused on obtaining a better understanding of the validity of the genetic analysis that was carried out and the statistics underlying the conclusions reached.

For a refresher, a helpful illustration from the GAO report shows the underlying biology of the genetic analysis that was carried out in the Amerithrax investigation. Here we see photos of a typical colony of the Ames strain of *Bacilus anthracis* on an agar plate and four variant colony types that occurred at low frequency when the attack material was spread out on agar so that colonies arose from single cells of the overall population of bacteria that were present in the attack material:

Figure 2: Ancestral Ames Strain and Types of Morphs Found in the Evidence from the 2001 Anthrax Attack



DNA sequence analysis was employed to identify the changes that led to these variant colony shapes. The FBI then commissioned private laboratories to develop DNA-based tests (relying on polymerase chain reaction, or PCR, methodology) that could be used to screen the large bank of isolates of the Ames strain that the FBI had accumulated through a subpoena submitted to all 20 laboratories known to have isolates of the Ames strain. Developing these assays represented a new frontier in forensic genetics and it did not prove possible to develop tests for all of the mutations identified in the original DNA sequencing. In the end, four tests were developed by the four different contractors.

The Amerithrax report stated that of the 947 samples included in the final analysis, only eight showed all four of the DNA changes the tests were designed to detect. Seven of those samples came from the laboratory where Ivins worked (U.S. Army Medical Research Institute of Infectious Diseases, or USAMRIID) and one came from Batelle Memorial Institute in Columbus, Ohio. The FBI noted that there was a record of material being transferred from USAMRIID to Battelle, accounting for the sample found there.

The GAO analysis finds a number of significant issues with the FBI's work:

Source of Variant Types

First, the GAO report noted that during the development of the genetic tests, questions arose about the factors underlying the presence of variants and especially whether culture conditions might affect the relative populations of normal and variant types:

> Although the specific genetic mutations used as genetic markers to determine a match or exclusion were adequately characterized, the FBI did not conduct studies to understand the methods and environmental conditions that gave rise to the mutations. The FBI convened a team of scientists in 2007 to review the scientific methods. Finding no shortfalls or deficiencies in the basic methodologies they reviewed, they determined that the usefulness of the genetic markers was sufficient. The team also stated that the extent of research and development of the genetic tests at the date of their review was insufficient to determine whether the presence or absence of one or several of the genetic markers was associated with the evidence, was merely characteristic of normal culture practices, or possibly was affected by the sensitivity of detections of the genetic tests. The team recommended additional studies to characterize the genetic markers as a function of growth conditions, including the influence of growth time, growth media, and temperature.

The GAO reports that the FBI's response to these concerns when they were raised by the NAS panel was hardly encouraging:

> In response to questions from the NAS panel about this recommendation, the FBI

> stated that it considered such studies academic and did not conduct the recommended research.

But that is hardly a just an “academic” question. See this post of mine for a summary of the preparation of Ivins’ RMR-1029 flask, which the FBI treated as essentially a smoking gun. That flask had material from a large number of large scale cultures. Also, the sheer amount of very highly concentrated material in the recovered letters from the attack also suggest very large cultures were carried out to produce the attack material. By comparison, the material submitted by the laboratories in response to the subpoena would be from very small laboratory scale cultures, and so the growth conditions would have been quite different, quite likely affecting the ratios of variant types in the final populations produced.

Sample Submission

Besides the concerns about culture conditions affecting the presence of variants in the samples submitted, the NAS report highlighted a point that had been somewhat obscured previously. It turns out that the scientists responding to the subpoena showed huge variations in how they responded and what they considered to be separate laboratory populations worthy of sample submission:

> Our analysis of FBI documents shows that FBI searches at three specific laboratories identified hundreds of additional relevant stocks that laboratories did not submit to the repository in response to the subpoena. Specifically, we found that the FBI collected about 29 percent of the 1,059 repository samples through these searches.

That’s staggering. Nearly a third of the total repository of samples would not have been

present had the FBI not searched those three labs. From the Amerithrax report, we do learn that the three that were searched were USAMRIID, Dugway and Batelle. But what about the 17 sites submitting samples that weren't searched? How many populations were missed in the pool that was tested? The bottom line is that the FBI analyzed a pool of samples that very likely missed a huge portion of what should have been analyzed.

Validation

Very far into the process of developing the DNA tests, the FBI realized they needed to make an effort at validating their analysis. One of the validation attempts put one of the tests into huge question. Table 3 from their report shows this disappointing result:

Validation testing showed that for those results expected to be positive, no negative results were observed at or above the LOD for any of the genetic tests.[46] However, in the postvalidation testing, the negative rates were generally high. As shown in table 3, the negative rates for the postvalidation tests ranged from 0 percent to 43 percent for the undiluted samples from flask RMR-1029. (Appendix III breaks down the results of the replicate testing for each genetic test.)

Table 3: Sensitivity Results for Five Postvalidation Tests on Undiluted Samples from Flask RMR-1029

	Number		Sensitivity	
Genetic test	Replications from flask (positive samples)	Positive samples detected	Nonpositive results[a]	Estimated % negative rate[a]
A1	30	17	13	43.3
A3	30	29	1	3.3
D-1	30	23	7	23.3
D-2	30	24	6	20.0
E	30	30	0	0

Source: FBI, sensitivity statistics derived from 30 replicate samples selected from RMR-1029 using sample selection methods similar to the samples submitted to the FBI repository. | GAO-15-80

[a]Includes negative and inconclusive results as nonpositive results. The estimated negative rate is the number of non-positive results divided by the number of replications.

That's a completely unacceptable result. The test called A1, when run 30 times in a row on material from the "smoking gun" RMR-1029, failed to detect the DNA variation in 13 of those tests. It gave a false negative in 43% of the tests when run on a known positive. And yet the FBI relied on this worthless test as part of the evidence to close the case.

Exclusion of Samples With One Inconclusive Test

If reliance on a worthless test isn't disturbing enough, the GAO report also dug out a point that was obscure in the NAS report. The FBI stated all along that in carrying out their analysis of the submitted cultures, they chose to eliminate from consideration any culture that gave an inconclusive result on any of the tests. But it

turns out that there were some samples that definitely deserved further attention among those that were thrown out:

> The NAS report also raised concerns that the decision to remove samples with inconclusive or variant results contributed to the lack of completeness of the repository data. The report stated that a major concern was the restriction of its statistical analyses to the 947 samples that contained no inconclusive or variant results. Notably, the report showed that 4 of the 112 samples that were disregarded for having a single inconclusive or variant result scored positive for the three remaining genetic tests.

Think about that for just a minute. Recall that only 8 of the 947 included samples tested positive for all four changes. And yet there are four more potential samples that might have all four DNA changes that have three positives and one inconclusive among the 112 that had an inconclusive result.

Going back to find that information in the NAS report makes it even worse. It turns out that among the 947 samples included in the final analysis,there were only three that had three positive tests, so the four with three positives and one inconclusive among the excluded 112 is huge. Here is a table with those four samples:

In addition to the two 3-positive samples (+++) among the 947 samples, the four samples below also tested positive for 3 mutations (ordered by FBIR number):

052-026	+	+	+	inc	-	A1, A3, MRI-D
053-010	var	+	+	+	+	A3, MRI-D, IITRI-D, E
054-008	inc	+	+	inc	+	A3, MRI-D, E
054-066	+	Inc	+	+	+	A1, MRI-D, IITRI-D, E

Where did samples 052-026, 053-010, 054-008 and 054-066 come from? The falsely closed Amerithrax investigation needs to be reopened to follow these sloppily discarded leads.

EBOLA OUTBREAK RECEDING IN LIBERIA, STILL STRONG IN SIERRA LEONE

Back in late September, the press had a field day with a mathematical model developed by CDC that estimated that if left unchecked, the Ebola outbreak in West Africa could wind up infecting over 1.4 million people. Almost missed in the hysteria over that high number was the fact that this same model predicted that even with key public health measures (patient isolation, monitoring of at-risk population who had contact with infected people and safe burial practices) falling short of 100% implementation, the outbreak could be brought under control around January of next year.

Word has been leaking out for a while now that the rate of new Ebola infections in Liberia is falling. Reports in the Washington Post on October 29 and November 3 told us as much. A chart in the WHO Situation Report for November 5 drives home just how dramatic the decline in new cases has become:

As can be seen in the chart, the rate of new infections for the two most recent weeks is less than one fourth the rate at the peak of the outbreak. Unfortunately, the news for Sierra Leone is not as good. While the rate of new infections may be leveling off, it is not yet falling appreciably:

Digging into the WHO report a bit further, we can find some evidence for how this dramatic drop in new cases has been brought about. We see that 52% of cases are now isolated. The WHO target for December 1 has been set at 70%, with a target of 100% by January 1. When it comes to

management of dead bodies, though, the December 1 target has already been surpassed. WHO reports that 87% of the dead are being “managed in a safe and dignified manner” while the targets were set at 70% for December 1 and 100% for January 1. Also, although no benchmarks are reported, WHO states that 95% of registered contacts were reached daily (although in the text of the report, there are suggestions this number may be somewhat overstated).

It should come as no surprise that progress in implementing these basic measures has had a huge impact on bringing down the rate of new infections. It fits perfectly with the CDC mathematical model and it also addresses the known biology of Ebola infections. Patients are most infectious at or near death, so establishing safe burial practices is vitally important. Conversely, identifying infected individuals through daily monitoring of the at-risk population and then isolating infected individuals once symptoms begin means that far fewer people are exposed to people producing large amounts of virus.

Sadly, those who remain exposed are the health care workers who are providing care to those who are infected. Despite shortages of equipment and supplies, WHO and other organizations are doing their best to overcome those shortages and to beef up training to reduce risk to these brave people on the front lines in the work to control the virus. As of this November 5 report, 546 health care workers have been infected, with 310 of them dying. Only four new infections were reported for the week ending November 2, so it is hoped that this rate is also dropping.

Had the alarmists who insisted that this was a new super-strain of Ebola capable of airborne transmission (or even a strain developed in a bioweapons laboratory), it is doubtful that these basic public health measures would have had such a dramatic impact on the rate of new infections. Perhaps those folks can go back to railing about chemtrails or the evils of

vaccines, because basic boring science appears to be on the road to controlling the current outbreak before all of mankind succumbs.

In the meantime, we are at about two weeks into the three week incubation period both for anyone "exposed" by Craig Spencer or for Kaci Hickox (or anyone she "exposed") to show symptoms. No reports of transmission so far, and the odds of any cases showing up are dropping very rapidly from the already very low levels where they started.

GLARING FRONT PAGE ERROR BY DAVID SANGER, NEW YORK TIMES AS IRAN NUCLEAR NEGOTIATIONS NEAR DEADLINE

~~*See the update below, as of about 2:45 pm, the Times has changed the wording of the erroneous paragraph without adding a note of the correction.*~~ *Oops. I got off on the wrong paragraph when I checked back. See the comment from Tony Papert below*.

For someone who has written on a range of technical issues for many years, the error committed last night by David Sanger could not be worse nor come at a worse time for the important events he is attempting to cover. In an article put up last night on the New York Times website and apparently carried on page A1 of today's print edition, Sanger and the Times have garbled a key point at the heart of the negotiations between Iran and the P5+1 group of nations as they near the critical November 24 deadline for achieving a full agreement on the

heels of last year's interim agreement.

The article ostensibly was to announce a major breakthrough in the negotiations, although Gareth Porter had worked out the details of the progress last week. Here is what Porter deduced:

> The key to the new approach is Iran's willingness to send both its existing stockpile of low enriched uranium (LEU) as well as newly enriched uranium to Russia for conversion into fuel for power plants for an agreed period of years.
>
> In the first official indication of the new turn in the negotiations, Iranian Foreign Ministry spokesperson Marzieh Afkham acknowledged in a briefing for the Iranian press Oct. 22 that new proposals combining a limit on centrifuges and the transfer of Iran's LEU stockpile to Russia were under discussion in the nuclear negotiations.
>
> The briefing was translated by BBC's monitoring service but not reported in the Western press.
>
> Undersecretary of State Wendy Sherman, who heads the U.S. delegation to the talks, has not referred publicly to the compromise approach, but she appeared to be hinting at it when she said on Oct. 25 that the two sides had "made impressive progress on issues that originally seemed intractable."

As Porter goes on to explain, such an arrangement would allow Iran to maintain a large number of centrifuges continuing to enrich uranium, but because there would be no stockpile of low enriched uranium (LEU), the "breakout time" (time required to highly enrich enough uranium for a nuclear weapon) would remain at about a year. By having Russia convert the LEU to fuel rods for Iran's nuclear power plant, that LEU would be removed from any easy pathway

to a weapon. This would provide Iran the “win” of maintaining its present level of around 10,000 operational centrifuges but give the P5+1 its goal of a longer breakout time. The key here is that unlike a proposal in 2005 where Russia would take over enrichment for Iran, this new proposal would allow Iran to continue its enrichment program while shipping virtually all of of its LEU to Russia for conversion to fuel rods.

Sanger appears to start off on the right track with his article:

> Iran has tentatively agreed to ship much of its huge stockpile of uranium to Russia if it reaches a broader nuclear deal with the West, according to officials and diplomats involved in the negotiations, potentially a major breakthrough in talks that have until now been deadlocked.
>
> Under the proposed agreement, the Russians would convert the uranium into specialized fuel rods for the Bushehr nuclear power plant, Iran’s only commercial reactor. Once the uranium is converted into fuel rods, it is extremely difficult to use them to make a nuclear weapon. That could go a long way toward alleviating Western concerns about Iran’s stockpile, though the agreement would not cut off every pathway that Tehran could take to obtain a nuclear weapon.

But about halfway through the article, Sanger displays a shocking ignorance of the real points of recent negotiations and somehow comes to the conclusion that Russia would be taking over enrichment for Iran rather than converting LEU into fuel rods:

> For Russia, the incentives for a deal are both financial and political. It would be paid handsomely for enriching

> Iran's uranium, continuing the monopoly it has in providing the Iranians with a commercial reactor, and putting it in a good position to build the new nuclear power reactors that Iran has said it intends to construct in the future. And it also places President Vladimir V. Putin at the center of negotiations that may well determine the future of the Middle East, a position he is eager to occupy.

Somehow, Sanger and his New York Times editors and fact-checkers are stuck in 2005, suggesting that Iran would negotiate away its entire enrichment program. Such a drastic move would never be contemplated by Iran today and we are left to wonder whether this language found its way into the Times article through mere incompetence or more nefarious motives meant to disrupt any possible deal by providing false information to hardliners in Iran.

At the time of this writing (just before 9 am on November 4), the Times still has not added any correction or clarification to the article, despite the error being pointed out on Twitter just after 10:30 pm last night (be sure to read the ensuing Twitter conversation where Laura Rozen and Cheryl Rofer work out the nature of the error).

Update: ~~And now, around 2:45 in the afternoon, I see that the Times has changed the erroneous paragraph. So far, I don't see a note that a correction has been made. Here is the edited paragraph~~:

> Russia's calculus is also complex. It stands to gain financially from the deal, but it also has an incentive to see the nuclear standoff between Iran and the rest of the world continue, because an embargo keeps Iranian oil off the market. With oil prices falling, a flood of exports from Iran could further depress prices.

~~Will they ever get around to adding a note? I'll keep an eye out.~~ Well dang, this is embarrassing. I went to the wrong paragraph when I looked back. The article is still unchanged. Thanks to Tony Papert in comments for catching my bone-headedness.

WAS QUANTUM ENTANGLEMENT EXPERIMENT BEHIND "CLASSIFIED CRYPTOGRAPHIC EQUIPMENT" CONFUSION AFTER ANTARES CRASH?

Yesterday evening, an Antares rocket built and operated by Orbital Sciences Corporation exploded shortly after liftoff. The rocket was intended to ferry supplies and equipment to the International Space Station. Orbital and Spacex have taken over some of the duties supplying the space station since the termination of NASA's shuttle program.

In the early aftermath of the explosion, word came out that the crash site had to be secured because sensitive cryptographic equipment was on board:

> The Cygnus mission was non-military, but the company's Antares program manager, Mike Pinkston, said the craft included "some classified cryptographic equipment, so we do need to maintain the area around the debris in a secure manner".

That initially struck me as odd. The International Space Station has a large number of cooperating countries, including Russia. It's hard to imagine that the US would put sensitive equipment into the hands of cosmonauts right now, given the cool state of US-Russian relations. Of course, it would make sense for ISS communications to be encrypted in order to prevent meddling by hackers, but movement all the way to classified (and presumably military or NSA-level) encryption seems to be excessive.

This morning, we are seeing walk-back on the presence of classified equipment:

> Shortly after the explosion, CNN quoted a launch director as saying that the spacecraft contained classified "crypto" equipment, but early Wednesday a NASA spokesman said by email that "We didn't have any classified items on board."

In trying to make sense of what could have been behind these strange statements, I ran across this interesting announcement of a new cryptographic technology that European scientists have proposed evaluating in an experiment on the space staion:

> A team of European researchers have proposed a series of experiments that, if successful, could turn the International Space Station into a key relay for a quantum communications network.
>
> The key basis of physics underlying quantum communications is entanglement. Entangled particles are connected in a way that pretty much defies common sense. If you change the spin of one of the particles, the spin of its entangled counterpart will change — even if they're miles apart. And that change happens nearly instantaneously — at least four orders of magnitude faster than the speed of light, according to a

> recent experiment.

Another remarkable aspect of this technology that sounds almost too good to be true is its potential security. After noting that quantum networks are quite fragile, the Forbes article continues:

> But why bother with these networks at all if they're so fragile? The answer is pretty simple — because they're almost perfectly secure. Here's how it works. Let's say that I want to send a message to New York City. My message is going to travel through normal channels, but it will be encrypted with a key. That key is transmitted via the entangled photons — so the changes I make to entangled particles on my end almost instantly show up in the particles in New York. We then compare the measurements of what I changed in my photons to those states in New York City.
>
> Those measurements then comprise an encryption key for our communications. So even if our communications are bugged, nobody can read them without knowing that encryption key. And here's the important thing: if somebody were to try to eavesdrop on the quantum entanglement, they would alter the spin of the photons. So the measurements I make and the measurements made in New York would be out of sync — thus letting us know that we have an eavesdropper. It also prevents us from creating an encryption key, so we don't send any communications. Theoretically, a quantum encrypted network is almost perfectly secure. (That said, they're not perfect, and there are some exploits.)

The announcement from the European group that they wished to carry out the experiment based on what Einstein called "spooky action over a

distance” came last April. Then, in June, it was announced that China had carried out a key demonstration of concept experiment back in 2010 but waited four years to publish the result.

With China announcing progress on the technology, one would think that the West would want to accelerate its work in the area, so it would not be at all surprising if equipment for the European experiment was among the items lost when the rocket exploded. Further, one would expect that Orbital would have been told that security for that equipment would be of the very highest level. In discussing the issue of sensitive equipment among the Antares wreckage, PCWorld this morning mentioned the incident of China perhaps examining the wreckage of the US stealth helicopter that was left behind after the mission to kill Osama bin Laden. It could well be that for this crash site, keeping the debris away from prying eyes from China is behind the call for security. Note also that the experiment quite likely would have been coordinated by the European Space Agency on behalf of the European scientists, so NASA’s claim that “We didn’t have any classified items on board” could be parsed as not applying to any classified items that ESA might have had on the rocket.

CHRISTIE’S QUARANTINE OVER-REACTION IGNORES HOW EBOLA IS TRANSMITTED

It’s really difficult to say which poor response to Ebola has done more damage to the public health system in the United States. First, we had the series of unforgivable errors at Texas Health Presbyterian Dallas that resulted in

Thomas Duncan being sent home with Tylenol and antibiotics when he first presented with Ebola symptoms. This was followed up after he was admitted by Nina Pham and Amber Vinson coming down with the disease after they treated him. Now, we have Kaci Hickox, who treated Ebola patients in West Africa, confined to an unheated tent in a New Jersey hospital for 21 days even though she is asymptomatic and has tested negative for Ebola. Twice.

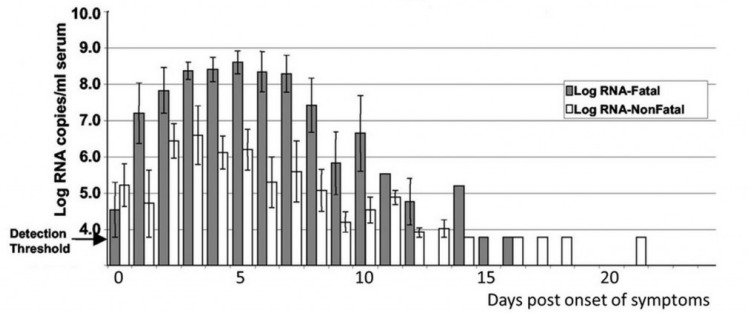
The hysteria over retracing the steps of Craig Spencer in New York City just before he developed his fever illustrates the way the US press has misled the public about when and where Ebola risk exists. Abundant evidence from this and previous Ebola outbreaks demonstrates clearly that there simply is no risk of transmission from asymptomatic patients and that transmission risk grows through the course of the infection.

We see that principle demonstrated very clearly in Duncan's case history. See this terrific ABC timeline for relevant dates quoted below. Duncan arrived in Dallas September 20. No passengers on any of the flights he took have developed Ebola. The incubation period has elapsed, so we know that no transmission of the virus occurred during any of his flights. Duncan had symptoms on his first hospital visit on September 26 but was sent home. He was later admitted on September 28. No patients or personnel from the hospital became infected from his visit September 26. The incubation period has expired, so we know for certain that transmission did not occur for anyone near Duncan that day. Similarly, even though they were in the apartment with him for days after he developed symptoms, none of the residents of or visitors to the apartment where Duncan was staying in Dallas became infected. The incubation period for that exposure also has expired. From this timeline developed by the New York Times, it appears that Pham and Vinson treated Duncan on the day before he died, which would be at the time when the amount of virus being produced by

his body was nearing its maximum.

The load of virus in a patient's blood over the course of Ebola infection has been studied. In this CDC review, we have a graph showing the amount of virus over time:

Figure 1. Ebola virus RNA copy levels in sera over time from 45 Ebola Virus Disease (EVD) patients (27 fatal, 18 non-fatal)[14]



On first glance, one might think that this graph doesn't show much difference between the viral load at the onset of symptoms and the maximum output of virus. But if we look at the vertical axis of the graph, we see that what is plotted is the log (or logarithm) of the number of copies of RNA (the virus genetic content) per milliliter (mL) of of blood serum. That means that the number on that axis tells us how many zeros are on the number of virus particles. The axis begins at "4", which means 10,000 virus particles per mL, which is also noted as the lower level of detection for the way the measurement was carried out. So from this graph, we see that on day 0 (which would be before symptoms are shown), the viral load ranges from undectectable to around the tens of thousands of particles per mL. Once symptoms develop, that load jumps dramatically, to tens of millions per mL. That represents a jump of around three logs, or a factor of 1000 times more virus in the blood. A few days later into the infection, we see the load approaching a billion viral particles per mL, about a hundred fold higher than on the first day of symptoms.

That Duncan's family and friends, even though they were around him well into the time after he developed symptoms and yet did not contract the virus illustrates pointlessness of quarantining

Hickox or any other returning health care worker who treated Ebola patients. Before they become extremely ill, Ebola patients appear to be virtually incapable of transmitting the disease. To calm public hysteria that has been whipped up by the sensationalist reporting surrounding these cases, I can agree with calls for health care workers like Hickox to be kept in voluntary home isolation with monitoring twice a day for a fever. These are health professionals with a vested interest in detecting any symptoms once they develop (odds of survival appear to be better the earlier treatment is started), so self-monitoring of temperature should be enough, but if states want to waste precious health-care dollars sending someone out to take those temperatures, so be it. But an actual quarantine serves no purpose and creates a real barrier to those noble souls contemplating spending time on the front lines treating this horrible disease in an area where many of the health care providers have already succumbed due to the shortage of suitable facilities, equipment and supplies.

Fortunately, New York Governor Andrew Cuomo, who had originally gone along with Christie in implementing the quarantine policy for returning "high risk" individuals, relented last night and went with a more rational policy. Other states may well take some time and a few legal proceedings before sanity sets in.

The folly of the quarantine policy will be highlighted further once a few more incubation periods have elapsed. For example, we are 14 days into the 21 day incubation period since the October 13 flights Amber Vinson took back to Dallas once her fever was beginning to develop. There was much hysteria about people "exposed" on those flights. I will stick my neck out here and predict that we will see precisely zero people infected from being on those flights with her. Similarly, the hysteria around the Uber car, the bowling alley and the meatball shop visited by Craig Spencer just before he came down with symptoms will need another 17 days to

be proven baseless once we see that he didn’t infect anyone, either.

Ebola is deadly, but we simply must use what we know about it in applying our resources to fighting it.

Update: It appears that while I was writing this post, Christie is already beginning to admit his error because Hickox is now likely to be released.

DNA SEQUENCE ANALYSIS SHOWS EBOLA OUTBREAK NATURALLY OCURRING, NOT ENGINEERED VIRUS

I had really hoped I wasn’t going to have to write this post. Yesterday, Marcy emailed me a link to a Washington’sBlog post that breathlessly asks us “Was Ebola Accidentally Released from a Bioweapons Lab In West Africa?” Sadly, that post relies on an interview with Francis Boyle, whom I admire greatly for his work as a legal scholar on bioweapons. My copy of his book is very well-thumbed. But Boyle and WashingtonsBlog are just wrong here, and it takes only seconds to prove them wrong.

Shortly after getting the email and reading the blog post, I sent out tweets to this summary and this original scientific report which describe work on DNA analysis of Ebola isolated from multiple patients during the current outbreak. That work conclusively shows that the virus in the current outbreak is intimately related to isolates from previous outbreaks with changes only on the order of the naturally occurring mutation rate known for the virus. Further,

these random mutations are spread evenly throughout the short run of the virus's genes and there are clearly no new bits spliced in by a laboratory. Since I wasn't seeing a lot of traction from the Washington'sBlog post, I was going to let it just sit there.

I should have alerted last night when I heard my wife chuckling over the line "It is difficult to describe working with a horse infected with Ebola", but I merely laughed along with her and didn't ask where she read it.

This morning, while perusing the Washington Post, I saw that Joby Warrick has returned to his beat as the new Judy Miller. Along with the line about the Ebola-infected horse, Warrick's return to beating the drums over bioweapons fear boasts a headline that could have been penned by WashingtonsBlog: "Ebola crisis rekindles concerns about secret research in Russian military labs".

Warrick opens with a re-telling of a tragic accident in 1996 in a Soviet lab where a technician accidentally infected herself with Ebola. He uses that to fan flames around Soviet work in that era:

> The fatal lab accident and a similar one in 2004 offer a rare glimpse into a 35-year history of Soviet and Russian interest in the Ebola virus. The research began amid intense secrecy with an ambitious effort to assess Ebola's potential as a biological weapon, and it later included attempts to manipulate the virus's genetic coding, U.S. officials and researchers say. Those efforts ultimately failed as Soviet scientists stumbled against natural barriers that make Ebola poorly suited for biowarfare.
>
> The bioweapons program officially ended in 1991, but Ebola research continued in Defense Ministry laboratories, where it remains largely invisible despite years

> of appeals by U.S. officials to allow greater transparency. Now, at a time when the world is grappling with an unprecedented Ebola crisis, the wall of secrecy surrounding the labs looms still larger, arms-control experts say, feeding conspiracy theories and raising suspicions.
>
> /snip/
>
> Enhancing the threat is the facilities' collection of deadly germs, which presumably includes the strains Soviet scientists tried to manipulate to make them hardier, deadlier and more difficult to detect, said Smithson, now a senior fellow with the James Martin Center for Nonproliferation Studies, a research institute based in Monterey, Calif.
>
> "We have ample accounts from defectors that these are not just strains from nature, but strains that have been deliberately enhanced," she said.

Only when we get three paragraphs from the end of the article do we get the most important bit of information to be gleaned from the Soviet work on Ebola:

> Ultimately, the effort to concoct a more dangerous form of Ebola appears to have failed. Mutated strains died quickly, and Soviet researchers eventually reached a conclusion shared by many U.S. biodefense experts today: Ebola is a poor candidate for either biological warfare or terrorism, compared with viruses such as smallpox, which is highly infectious, or the hardy, easily dispersible bacteria that causes anthrax.

Note also that, in order to make Ebola more scary, Warrick completely fails to mention the

escape of weaponized anthrax from a Soviet facility in 1979, infecting 94 and killing 64, dwarfing the toll from the two Ebola accidents.

And lest we calm down about Ebola and the other bioweapons the Soviets worked on, Warrick leaves us this charming tidbit to end the article:

> "One must assume that whatever genetically engineered bacterial and viral forms were created . . . remain stored in the culture collections of the Russian Federation Ministry of Defense."

Okay, so after we finish peeing our pants over the warnings from WashingtonsBlogPost, here are the clear scientific data showing that the virus actually circulating in West Africa fits perfectly within the genetics one would expect from a natural outbreak. From the summary article, we have this:

> For their study, published in the August 28 online issue of *Science*, Gire's group sequenced viral DNA of samples collected from 78 confirmed Ebola patients in Sierra Leone between late May and mid-June. For 13 of these patients, they collected samples at multiple time points, resulting in a total of 99 viral genome sequences. They compared these Ebola genomes to each other, as well as to three published genomes from Guinea, and 20 sequences generated from previous Ebola outbreaks.
>
> The genomic analysis revealed that the current version of the virus in West Africa most likely spread from Middle Africa within the past 10 years. They also found that the viruses causing this outbreak and the two previous ones diverged from a common ancestor around 2004. This means that these outbreaks arose from different "jumps" from the animal reservoir to the human population. The similarity between

> samples from the current outbreak confirm that it originated from a single jump, and since that time the disease has spread exclusively from human to human. This is different from previous outbreaks, which had spread via multiple zoonotic events.

If we go to the paper in Science, here are the details of what was found in the DNA sequencing:

> We combined the 78 Sierra Leonean sequences with three published Guinean samples (3) [correcting 21 likely sequencing errors in the latter (6)] to obtain a data set of 81 sequences. They reveal 341 fixed substitutions (35 nonsynonymous, 173 synonymous, and 133 noncoding) between the 2014 EBOV and all previously published EBOV sequences, with an additional 55 single-nucleotide polymorphisms (SNPs; 15 nonsynonymous, 25 synonymous, and 15 noncoding), fixed within individual patients, within the West African outbreak. Notably, the Sierra Leonean genomes differ from PCR probes for four separate assays used for EBOV and pan-filovirus diagnostics (table S3).
>
> Deep-sequence coverage allowed identification of 263 iSNVs (73 nonsynonymous, 108 synonymous, 70 noncoding, and 12 frameshift) in the Sierra Leone patients (6). For all patients with multiple time points, consensus sequences were identical and iSNV frequencies remained stable (fig. S4). One notable intrahost variation is the RNA editing site of the glycoprotein (GP) gene (fig. S5A) (10–12), which we characterized in patients (6).

So they found a few hundred single changes in the coding sequence of the virus, spread throughout the genome of the virus. The most

important bit of the work is the next paragraph:

> Phylogenetic comparison to all 20 genomes from earlier outbreaks suggests that the 2014 West African virus likely spread from central Africa within the past decade. Rooting the phylogeny using divergence from other ebolavirus genomes is problematic (Fig. 2A and fig. S6) (6, 13). However, rooting the tree on the oldest outbreak reveals a strong correlation between sample date and root-to-tip distance, with a substitution rate of 8 × 10−4 per site per year (Fig. 2B and fig. S7) (13). This suggests that the lineages of the three most recent outbreaks all diverged from a common ancestor at roughly the same time, around 2004 (Fig. 2C and Fig. 3A), which supports the hypothesis that each outbreak represents an independent zoonotic event from the same genetically diverse viral population in its natural reservoir.

Translating from the technical language here, what the scientists are saying is that if they compare the DNA sequence data from this outbreak to data from previous outbreaks, it is clear that all of the isolates seen are quite similar. The computer programs for graphically representing these relationships are thrown off slightly by the facts that there is diversity in the pool of viruses circulating in the wild and that the virus also tends to mutate over time. By making the logical assumption of “rooting” the relationships among isolates by putting the oldest one at the bottom of the “tree”, the relationships then all fit perfectly and allow a calculation of the mutation rate over time. Simply put, if the virus circulating now were a product of laboratory manipulation to change the virus, it is very likely that the number of changes that would have been introduced would have blown up the phyologenetic analysis of the current outbreak virus when compared to previous

outbreaks. The only way an engineered virus could be involved in this current outbreak would be if somehow a scientist understood how just a very small number of single nucleotide changes could make this virus suddenly more virulent.

While there is a hint that perhaps this virus may be more virulent in the evidence that this outbreak may trace to only one jump from a host species instead of several (although I've seen analyses suggesting that this outbreak was just unlucky in getting to highly populated areas quickly, accounting for its spread) the authors of the study demonstrate that our knowledge of Ebola is not yet at a level where one could put just those few changes into the genome to achieve higher virulence. In fact, one of the driving reasons for carrying out this study was to identify just those changes that can affect virulence so that the information can possibly be put to use in developing vaccines or other treatments, as seen in the final two paragraphs of the publication:

> As in every EVD outbreak, the 2014 EBOV variant carries a number of genetic changes distinct to this lineage; our data do not address whether these differences are related to the severity of the outbreak. However, the catalog of 395 mutations, including 50 fixed nonsynonymous changes with 8 at positions with high levels of conservation across ebolaviruses, provides a starting point for such studies (table S4).
>
> To aid in relief efforts and facilitate rapid global research, we have immediately released all sequence data as it is generated. Ongoing epidemiological and genomic surveillance is imperative to identify viral determinants of transmission dynamics, monitor viral changes and adaptation, ensure accurate diagnosis, guide research on therapeutic targets, and

> refine public health strategies. It is our hope that this work will aid the multidisciplinary international efforts to understand and contain this expanding epidemic.

As a sad postscript, the paper is dedicated to five health care workers among the paper's authors who died of Ebola during the time the manuscript was in preparation:

> Tragically, five co-authors, who contributed greatly to public health and research efforts in Sierra Leone, contracted EVD and lost their battle with the disease before this manuscript could be published: Mohamed Fullah, Mbalu Fonnie, Alex Moigboi, Alice Kovoma, and S. Humarr Khan. We wish to honor their memory.