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The Making of National Estimates during the Period of the 'Missile Gap'

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In the middle and late 1950s the United States intelligence community was called upon to assess the emerging ability of the Soviet Union to threaten the North American continent with intercontinental ballistic missiles (ICBMs). Penetrating the shroud of Soviet secrecy to determine the status and direction of a nascent missile program became an increasingly controversial enterprise, and heated debates arose among the intelligence community, the government and finally the public.

The vehicle used to disseminate among decision-makers the supposed consensus of the intelligence community was the National Intelligence Estimate (NIE). The lack of concrete information on Soviet accomplishments and the pressure from those with a 'need to know' where the Soviet ICBM program was headed began to be reflected in the NIEs themselves. With spectacular successes in rocketry following each other in rapid succession, and an effusive Soviet leader rampaging through international fora with a euphoria smacking of reckless abandon, the Soviet Union managed to create in the public mind the myth of a 'missile gap'. Meanwhile, under the heading 'top secret', a systematic overestimation of Soviet progress in the deployment of intercontinental ballistic missiles was taking place.

The concern here is with this overestimation. An attempt will be made to survey and analyse the availability and utilization of data from various methods of covert intelligence collection, and the role they played in the NIEs. There will be little discussion of the organizations involved or the personalities ensnared in the 'missile gap' debate. On the other hand, an attempt will be made to provide at least an organizational analytical framework for the material. Finally a historical argument will be made which departs from previous accounts: the eventual 'closing of the gap' – that is, the drastic downward revision in the projection of the Soviet ICBM force – was not primarily due to the emergence of satellite reconnaissance but to old-fashioned spying.

The first step is to present the figures that form the basis of the article; only a few of the NIEs have been declassified, but fairly reliable figures are available on most of the ones that matter. Second is an investigation of the assumptions that underlie the derivation of the figures in the NIEs. After a discussion of economic intelligence, which not only has a special

TABLE 1

SUMMARY OF NIE FORECASTS OF SOVIET ICBM FORCES – 1954–63

Estimate	*Date*	*mid-1959*	*mid-1960*	*mid-1961*	*mid-1962*	*mid-1963*	*mid-1964*
NIE11-6-54	?						
NIE11-4-54	08/28/54						
NIE11-3-55	05/17/55	no operational capacity before 1960					
NIE11-5-57	03/12/57			'a few'	500		
NIE11-4-57	11/12/57	'a few' (10)					
NIE11-10-57	01/05/58	'a few'		500*	500		
NIE ?	08- ?/58			500*	500		
NIE11-4-58	12/23/58	10(100*)	100	500*	500		
NIE11-4-59	02/09/60			140-200	250-350	350-450	
NIE11-60	04/12/60						
NIE11-8-60	08/01/60						
	Program A (CIA)		30	150	270	400	
	Program B (Air Force)		35	200	450	700	
	Program C (Army-Navy)		'a few'	50	125	200	
NIE11-4-60	12/01/60				125-450	200-700	?-950
NIE11-5-61	04/25/61						
NIE11-8-61	06/07/61			few-200	50-300	100-550	150-850
NIE11-8/1-61	09/21/61			10-50	?-100	75-250	
NIE11-4-61	01/10/62				35-100	100-250	150-450
NIE ?	02/ /63				80-160 (end-of-year)	120-150	175-450

* assuming 'crash' program

Sources:

McQuade–Nitze Memo, 'But Where Did The Missile Gap Go?' 31 May 1963.
McNamara–Kennedy Memo, 'The Missile Gap Controversy', 4 March 1963.
NIE 11/4/57.
NIE 11/4/54.
NIE 11/3/55.
John Prados, Dissertation, pp.88–9, 101, 133, 201 (see also Prados *The Soviet Estimate*, table, p.89).

status among intelligence sources but also plays a particularly prominent role in the NIEs under investigation, a survey of the other major sources of intelligence concludes the article.

THE FIGURES

Table 1 presents a summary of projections of the Soviet ICBM force made by various National Estimates between 1954 and 1963. Only figures from highly reliable sources are used. The early estimates (1954–55) were fairly cautious and predicted little or no capability. Between NIE 11–5–57

and NIE 11–4–57 the USSR tested two ICBMs and launched the Sputnik satellites. The latter estimate predicted that 'a few (say 10)' ICBMs might be available to the Soviets by 1959. This is a year earlier than projected in the previous estimate, a shift which intuitively does not seem imprudent. Interestingly enough, NIE 11–4–57 dropped an outyear projection of 500 missiles made by its predecessor. This is in keeping with the overall cautious tone of the estimate. A further contrast is provided by a joint American–Canadian forecast made during a conference on Soviet capabilities in January of 1958. The two nations registered divergent opinions. The US view was that an initial operational capability (IOC) of up to ten prototype missiles might be available during mid-1958 to mid-1959. The Canadian view, on the other hand, was that 'this weapon [the ICBM] will not be a threat to North America before 1960'.[1] The unwillingness of the Canadians to commit themselves numerically supports the view that specific data were sparse.

The 1958 NIEs had an 'alternative program approach'. Projections of 100 and 500 for mid-1960 and mid-1961 were moved up a year if, rather than an orderly program, the deployment was assumed to be conducted on a 'crash' basis with 'overriding' priority. By this time, about 10–15 Soviet missile test firings had taken place, none of them over distances of more than 3700 nautical miles (n.m.).[2] Since April 1958, however, eight months before this estimate, no firings at all had taken place.

With the benefit of hindsight, it is evident that by 1960 (NIE 11–4–59) a pattern of serious overestimation began to form. Furthermore, beginning with this estimate the units counted were no longer missiles, but deployed launchers. Typically, the Air Force estimate constituted the upper limit of the range, while the Army and the Navy were the most optimistic. The CIA, I&R, and DOD would fall on the high side of the middle. The ranges peaked in NIE 11–8–60 and NIE 11–4–60, with a current force between 'a few' and 35 assumed, and a mid-1963 range of 200-700 projected. In May 1960, U-2 pilot Francis Gary Powers was shot out of the sky by a Soviet surface to air missile, terminating a valuable source of information for the US. After August 1960, there was another standstill in the testing program of the USSR, and in the latter half of the year, the first photographic capsules from Discoverer reconnaissance satellites were recovered. The next available figures, for NIE 11–8–61, showed a slight downward adjustment from the 1960 estimates, but it was not until September 1961 that a radical downward revision of previous figures took place. This is the signal in the NIEs for the closing of the missile gap. It is notable, however, that primarily the outyear forecasts were revised, suggesting the possibility that significant new information on the currently deployed ICBM forces was still not available.

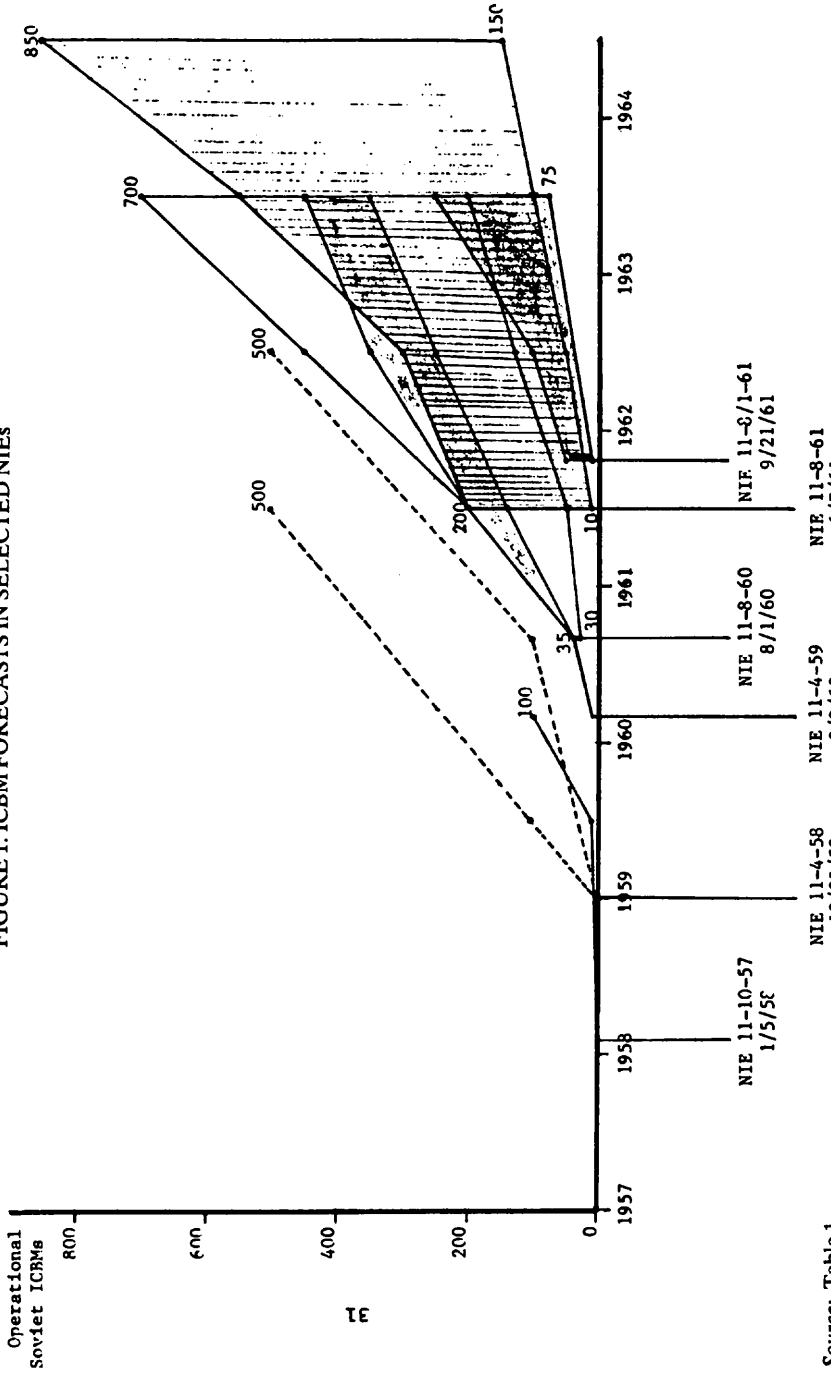

FIGURE 1: ICBM FORECASTS IN SELECTED NIEs

Source: Table 1

THE ASSUMPTIONS

A glance at Figure 1 will impress what is perhaps the most fundamental observation that can be made about the NIEs of this period: there was profound uncertainty. The observation is not trivial, for it is the causes of this uncertainty that concern us here. Investigations will show that on the one hand there was uncertainty about the *accomplishments* of the Soviets in their ICBM program. On the other hand the *intentions and capabilities* of the Soviets had to be assessed, and predictions had to be made concerning the future of their ballistic missile force. The uncertainty of these predictions in turn had several components. Besides, whatever nominal uncertainty attached to claims about the future, there was here, as in the assessment of Soviet achievements, uncertainty rooted in the quality of the raw information. In addition, because the Soviet ICBM program was in its infancy, its precise developments could not be known even to those participating in it, let alone to intelligence services seeking to monitor it clandestinely. The accident caused by an explosion on the launching pad of a Soviet test ICBM in April 1960, which killed several hundred scientists and resulted in an eight-month hiatus in testing, leaves no doubt that the Soviets themselves had to re-evaluate their capabilities and intentions.[3] Increased uncertainty is pitted here against the increased importance of prediction in the intelligence analysis of a nascent program.

The final component of uncertainty in the prediction of capabilities and intentions is due to the underlying assumptions and interpretations of the raw data. It is to these that we now turn.

A detailed 1953 report on Soviet guided missile intelligence gives a good idea of how estimates of Soviet capabilities were arrived at. Based on a joint Anglo-American conference held between 8 and 26 September 1952, it makes explicit the assumptions that enter into its forecasts. Given the thrust of various rocket engines reported to be under development in the USSR, various assumptions were made *on the basis of US research* and the ranges of potential missiles were calculated. Thus,

> in calculating ballistic ranges, the missile gross weight was first determined from the relation of optimum thrust to gross weight; an estimated weight breakdown of propulsion system, structure, guidance and control equipment, etc., was made on the basis of empirical relationships established by studies performed in the U.S. and the weight remaining for propellants and payload calculated. Since it is assumed that atomic warheads will be used in the larger missiles, a range of warhead weight values is fixed and propellant capacities can be established.
>
> When values of thrust, gross weight, and propellant weights have

> been fixed, the power-on missile trajectory can be computed and from the cut-off velocity, the elliptical ballistic trajectory can be calculated. The total range can then be obtained to a good approximation by adding the burn-out range, burn-out altitude and elliptical range.

The report further assumed that the Soviets did not yet have the capability to equip their missiles with inertial guidance systems but that development of radio-controlled Doppler guidance systems, which guide the missile by controlling the fuel cut-off point, would not impede the progress of the program. A further assumption was that the 'time phasing between design, fabrication and testing' was based on research schedules of similar US programs.[5]

The approach employed in this report is one that remains fairly consistent throughout the NIEs we are investigating. Certain performance characteristics are assumed; given these characteristics, projections of various stages in the program are made given whatever other intelligence information is available. The first guided missile estimate, NIE 11–6–54, has not been declassified, but apparently stated that no firm information was available.[6] Still focusing exclusively on IRBM/MRBMs, NIE 11–4–54 of 28 August 1954 specifies two capabilities, and makes projections for them. A missile with a range of 900 n.m., carrying 3,000 lb warheads, could be operational by 1957, and a missile with a 1,300 n.m. range by 1958–60. NIE 11–4–54 indicates another factor that becomes important in evaluating the raw intelligence in the NIEs. Tacitly or explicitly, an assumption had to be made about the pace with which the Soviets pursue their program. In later estimates, this leads to large spreads in the projections of the Soviet ICBM force depending on whether or not one assumed the program would be pursued on a 'crash' basis. Thus, in a dissenting note to the above mentioned projections, the Director of Intelligence, USAF. maintained that the 900 n.m. missile could be available in limited operational quantities in 1955, and the 1,300 n.m. missile in 1957. Specifically,

> This belief is based on the intelligence of early Soviet exploitation in Germany, on Soviet interests in guided missiles up through 1952, and the demonstrated ability to follow a concerted development program as witnessed by the rapid development in aircraft, armament and electronics in the past eight years.[7]

The indication here is that little evidence beyond that which produced the 1953 report was available, and this of course raises the question of how the 900 n.m. and 1,300 n.m. ranges were decided upon as indicative of the Soviet program.

NIE 11–3–55 of 17 May 1955, retrenched somewhat from the previous estimate; and after noting that it was likely that the 'Soviet Union now has some guided missiles in operational status and that a growing Soviet guided missile capability will develop within the next several years', it asserts that the available intelligence is insufficient to make a more precise estimate.[8]

By 1957,[9] the performance parameters that would be used in projections of the Soviet ICBM force over the next several years had crystallized. Where these figures originated is unclear. NIE 11–4–57, dated 12 November 1957, states that its projections are based on the assumption that the Soviet ICBM would have a range of 5,500 n.m. and a circular error probable (CEP) of 5 n.m. It mentions the 'probable firing of two test vehicles in the summer of 1957'.[10] Yet these tests almost certainly did not involve ranges of this magnitude. The first full-range test shot to a target in the Pacific Ocean 5000 n.m. away did not occur until after April 1959.[11]

NIE 11–4–57 made explicit two other important assumptions. The first was again an assumption on the pace of the Soviet program; the 'estimate [was] predicated upon a top priority flight test program over a period of about two years from the first firing of a test missile this summer'. The second was that the initial operational capability (IOC) would employ prototype rather than series-produced missiles.[12] Both these assumptions would later be relaxed, and much of the missile gap debate in the administration, in Congress and in the press in years to come would hinge on the applicability of these conservative assumptions.

Beginning with the special estimate on the Soviet ICBM program, SNIE 11–10–57 of 5 January 1958, NIEs are not yet declassified. There is evidence, however, that the August 1958 NIE for the first time included the assumption that the Soviets might pursue their ICBM program on a 'crash' basis. The addition of this assumption had the effect of moving the predicted number of operational missiles a year closer (500 before the end of 1961 rather than 1962).[13] The result was of course to broaden the range of the estimates considerably, and thus most likely to limit their usefulness to decision-makers. The crash program/orderly program distinction continued into the next estimate, NIE 11–4–58, dated 23 December 1958. Again the effect was to introduce a spread of one year into the numerical predictions.[14]

During 1958 and 1959, very little new raw intelligence seems to have become available to the US intelligence community. In April 1958 there was the last Soviet ICBM shot before testing ceased for approximately a year. Meanwhile the most valuable source of intelligence, the U-2 reconnaissance plane, was grounded in July 1958, and very few overflights of the USSR took place in the following 20 months. Nor did

the early Discoverer satellite launches provide intelligence during 1959. On the other hand, when Soviet ICBM testing did resume, it did so intensively, and included the first full-range ICBM test. It appears that uncertainty was at its height during this period and that there was little constraint on assumptions the intelligence community could make in its projections.[15]

NIE 11–4–59 is the first estimate to reflect a basic shift in the assumptions underlying projections. The shift, in simplified terms, was one from 'bean counting' to 'threat analysis'. The reasoning was that since the main concern of the US was to maintain a credible deterrent, what mattered was the Soviet 'salvo capacity', or the firepower they could deliver against US strategic forces in a first strike. An IOC was already available to the Soviets at this point; instead of prototype ICBMs, 'the deployment program was a useful estimative target'.[16]

Two of the assumptions that had been made in NIE 11–4–57 were thus revised by 1960. First, prototypes were no longer counted; rather, launchers deployed became the yardstick of future Soviet capability. This change was undoubtedly spurred by the realization – to become abundantly clear in future arms control verification debates – that it was impossible to count actual missiles with even the finest technical means of collection.

The second assumption, which was, if not discarded, at least relaxed, was that a 'top priority flight test program over a period of two years' would be followed by the Russians. An orderly program, even with top priority, was not a sufficiently conservative assumption for analysts who suspected that ICBM deployment in the USSR might be taking place on a crash basis. As McNamara appraised in 1960 there was

> general agreement within the intelligence community on the ICBM test program, and on the characteristics of the system, but disagreement on the scale and pace of deployment.[17]

This disagreement was at the heart of the debate over Soviet capabilities versus intentions. Officially, NIE 11–4–59 and subsequent NIEs concluded that the Soviet Union was not pursuing its ICBM program on a crash basis. To add further fuel to the fire, the same estimates also assumed that the Soviet strategic aim was to deploy a deterrent and pre-emptive strike force rather than a first-strike force, and concomitantly that the Soviets believed that it was not within their reach to prevent the US from having a devastating retaliatory capability.[18]

Interestingly enough, the shift to threat analysis at this point indicated that the missile gap was receding. It could be calculated that in order to destroy 90 per cent of a fairly complete target set, including all SAC bases, unhardened ICBM sites and command installations more than

1,100 n.m. from the Soviet Union, 270 missiles (assuming optimal missile characteristics) would be required in 1960, 440 in 1961, 1,200 in 1962 and 3,900 in 1963. However, the picture would not look as rosy if only the bomber bases constituted the target set.[19] These considerations are not reflected in the figures reported for the 1960–61 NIEs; they may, however, be an explanation for the nonchalance with which decision-makers, in particular Eisenhower, apparently treated some of the more alarmist intelligence forecasts.

By 25 April 1961, the date of NIE 11–5–61, intelligence data from new sources, including the SAMOS 2 satellite, the Soviet defector Lieutenant Colonel Oleg Penkovskiy, a total of four Discoverer capsules and renewed intensive test activity by the Soviets became available, although it is not certain what the quality of this information was and to what extent it was evaluated in time for the estimate.[20] With this information it appears that assumptions of an accelerated Soviet deployment program were no longer tenable. On 6 February 1961 Secretary of Defence McNamara informed reporters off the record: 'There appeared at this time no signs of a Soviet *crash* effort to build intercontinental missiles'.[21] Instead it became clear that the Soviets were working on their second generation of ICBMs. As a consequence, on 7 June 1961, there were downward revisions in NIE 11–8–61. Yet the evidence was not conclusive and did not dispel claims that the Soviet ICBM force might be much larger. Thus the Air Force tried, for example, to demonstrate through statistical methods the likelihood of the existence of unknown ICBM bases, and the effectiveness that camouflage might have in hiding such bases from the eyes of US intelligence.[22]

On 21 September 1961, NIE 11–8/1–61 was approved. It radically revised Soviet ICBM projections due to a 'critical intelligence breakthrough'.[23] What was that breakthrough? The preceding discussion suggests that whatever it was, it must have not only revealed the presence or absence of missile sites, but also provided substantial proof against those making the most alarmist assumptions. It is unlikely that even complete photographic coverage of the entire Soviet Union, if it was available, could have accomplished this. SAMOS 2, even if it did supply usable pictures, had done so in January and the results should have been apparent in earlier estimates. The Discoverer program, on the other hand, provided much of its valuable information between June and July – in the course of the summer, as was to be expected.[24] With stepped-up analysis, the contribution of Discoverer to the closing of the intelligence gap cannot be discounted. Given the time required to complete the NIEs, however, and the conclusiveness of the evidence, the 'breakthrough' was most likely the three rolls of microfilm on the status of Soviet rocketry provided by Oleg Penkovskiy in May 1961. Penkovskiy worked as

Deputy Chief of the Foreign Section of the State Committee for the Coordination of Scientific Research Work, but was in fact a colonel in the Soviet military intelligence service (the GRU). On 20 April 1961 he first approached the British in London saying that he was ready to provide sensitive information. Provided with a Minox camera he produced a wealth of material, and a month later passed on the first batch to his contact in Moscow, Greville Wynne.[25]

Were the assumptions and interpretations underlying the NIEs unreasonable? Organizational interests, electoral politics and personal ambitions undoubtedly played their role, especially in the public debate, but these were neither the only nor necessarily the most important factors. High among the influences on American judgements were Khrushchev's persistent rhetoric regarding Soviet accomplishments and capabilities; judgements by scientists and economists as to what was *possible* in terms of potential; and the general perception of earlier intelligence and military assessments that had been made of the Soviet missile threat.[26] These assessments are perhaps best summed up in the words of one of the first major suppliers of post–war intelligence on the Soviet Union, Colonel G. A. Tokaty-Tokaev:

> The immediate aim of the Soviets is to get a selection of reasonably effective guided missiles into service as soon as possible. They are prepared to accept relatively unsatisfactory weapons available today rather than wait several years for greatly improved designs. They will go for modifications which show some improvements and can be achieved quickly.[27]

This perception of the Soviet tendency to invest heavily in marginal systems persists even today, and it is reasonable to assume that it bred caution among analysts of scarce intelligence data at the time. Finally there is what Lawrence McQuade calls our 'sense of tempo of the program and our judgement as to the relationship between what we have detected and what we are likely to have missed'.[28] In a word, uncertainty.

ECONOMIC INTELLIGENCE

The role of economic intelligence in the period under consideration was twofold. On the one hand, it suffered from a similar lack of data as the guided missile estimates. On the other hand it was expected to provide the substitute for just those data in the projections of future Soviet ICBM capabilities.

In 1960, as has been mentioned, a vigorous public debate erupted over ignoring the 'capabilities' and basing ICBM projections on Soviet 'intentions'.[29] Capabilities in the context of the future ICBM force had

nothing to do with capabilities as they are usually considered in military-strategic contexts. Today, when we speak of Soviet 'capabilities' we are most likely to be concerned with the possible damage they can inflict on the US, militarily or politically speaking, given their arsenal of ICBMs, armored divisions or whatever else is under consideration. When the NIEs spoke of capabilities, however, they were speaking primarily of production capacity or economic potential.

By substituting extrapolations of production capacities for the raw data that were lacking regarding the progress of the Soviet missile program, the intelligence community left itself open to attacks such as that of James C. Dick:

> Had the Russians wished to build a counterforce contingent of first-generation missiles – to construct a new factory if needed, to lay down hundreds of launching pads in rapid order, perhaps to let other sectors of the economy fall into disarray and stagnation – they *could* have done so, albeit in a sense of that word that stretches the political imagination.[30]

Persiflage or not, this argument does point to the basic shortcoming of economic capability forecasts – they must take into account what is politically feasible and the intentions of the decision-makers.

How then did the numbers come about? The early estimates indicate that, at the macro-economic level at least, overt sources are of primary importance. NIE 11–4–55 and NIE 11–7–57 contain repeated references to the forecasts contained in the official five-year plans for such items as investment in heavy industry and production goals.[31] Other contributing factors to the determination that are isolated in the NIEs include the size of the labor force, percentage of GNP dedicated to defense and investment, number of persons graduating with technical degrees and the availability of raw materials. In NIE 11–4–57, for example, given past trends of resource allocation, a decline in the growth of the labor force, and a continually high rate of investment (25 per cent), a decline in GNP from seven to six per cent is predicted. Defense expenditures, extrapolating from historical data, are then measured in percentage of GNP, and a figure of 15 per cent is projected of which nuclear weapons are expected to account for more than 35 per cent.[32]

The NIEs, typically quite cautiously phrased, do not try to sell their economic forecasts as hard facts. Thus caveats are frequently entered in the text and notes, such as this one on the Soviet GNP figures:

> Considerable technical difficulties arise in calculating the GNP of any country. In the case of the USSR, the limited nature of the available data makes the calculation an interpretation especially

> difficult. We believe nevertheless that they present a reasonably accurate index of general trends in the Soviet economy.[33]

Other examples include reminders on the lack of data on labor force figures and statements of limited accuracy (90 per cent) in figures on scientific personnel. NIE 11–3–55 notes the following three assumptions underlying the economic projections for 1955–60: a) recent rates of growth are projected into the future; b) current investment programs are also projected; c) announced Soviet plans are reconciled with these projections.[34]

The impression from these observations is that there is really no way to make any prediction of ICBM developments that can be taken seriously based on the type of information involved here. Indeed, economic intelligence would be quite trivial were this all that it amounted to. At the next level down from these macro-economic considerations, however, detailed studies are made of individual industries, plants and geographical areas. In a society as parsimonious with statistics as the USSR, the intelligence community must resort to the collection of clandestine data using the same resources as for collecting military, strategic and political data. As in these areas, the foundation for American economic intelligence used to predict the ICBM programs was provided by what the Germans had accumulated in terms of maps, aerial photographs, POW interrogations, etc. Detailed reports on destination, equipment and inventories removed from locations such as Peenemuende, a German V-2 rocket production site, were provided by interviews with repatriated Germans who had worked on the Soviet missile program. One difficulty with these sources was that their reports were often disparate, and that they were usually repatriated before production of any missiles began.[35]

With the advent of U-2 aerial photography,

> photographs taken by the U-2 of Soviet factories, combined with analysis of the particle content in the air in overflown areas, permitted a determination of the type of manufacturing activity within them. Given these data, estimates of monthly production rates could be calculated from the area of the factories. The number of shifts in a given factory could be estimated in accordance with the amount of ancillary civilian housing, and an estimate of productivity per shift could be contrived on the basis of comparable Western or American production norms. Additional evidence about the production rate of a particular factory might be gleaned from the analysis of railway traffic from a site and from the number and size of observable packing containers.[36]

This approach did not allow for the identification of most factories

involved in missile production, since most produce merely subcomponents and are thus more difficult to identify. The problem is compounded by the resulting geographic dispersion of missile production.[37]

Other difficulties encountered by economists in the service of the CIA arose from trying to price Soviet military items both in roubles, since realistic defense budgets are not published, and dollars, since the official exchange rate is not very useful. Furthermore, what few statistics are available are unclear in their derivation and inconsistent in their methodology.[38]

The effort to ascertain the Soviet capability should not be discounted out-of-hand. However, given the complexity of the task, the figures arrived at should not be taken as definitive. Whether the NIEs should present a numerical forecast regardless of the degree of uncertainty involved, and how useful they will be if they present false or no figures, is an interesting debate that will not be taken up here.

We have explored thus far two sources of uncertainty in the NIE forecasts; the variability of assumptions and methodology of economic forecasting of capabilities. Both could be mitigated but not eliminated by the availability of more 'raw' data. Both are also necessitated to some degree by the fact that the ICBM was a novel element in strategy and in the arms race, and that therefore prediction was at once most necessary and most difficult.

We will now leave the bulk of the numerical content of the NIEs which focuses on these predictions and concern ourselves with the attempt by intelligence to assess the *accomplishments* of the Soviet Union over the period under consideration. The vehicle for the discussion will be a survey of the 'raw' information constituting the input into the national estimates. The purpose will be not to provide a complete historical or technical account of each of the various techniques but to point out the capabilities and limitations of each through description and examples in an attempt to determine what information could and could not have been gleaned from them. Furthermore, the survey is limited to primarily covert collection efforts. This is not to degrade overt techniques, which are of at least equal importance. The rigorous exploitation and analysis of overt sources is assumed for the present purpose.

HUMINT

Human intelligence (HUMINT) was the most important source of intelligence regarding the Soviet missile program until at least late 1961. A large number of reports from Germans repatriated after the war, including technicians and prisoners of war, as well as refugees and repatriates of other nationalities, provided a good picture of Soviet

rocketry as late as 1952. This information provided a foundation for other sources to build on, including information on various rocket production and development installation and the test stand at Kaputsin Yar.[39]

Three important Soviet informants during the period were Colonel G.A. Tokaty-Tokaev, who had been chairman of the Soviet State Commission on missile development and gave information on Soviet policy discussions; Lieutenant Colonel Pyotr Popov, a disillusioned GRU case officer who provided copious information on a plethora of military matters; and Lieutenant Colonel Oleg Penkovskiy, whose contributions have been mentioned above.[40] But beyond this, there were numerous tourists, defectors and Soviet nationals, as well as agents 'planted' in the classic sense, who provided photographs of – among other things – missile plants for surface-to-air missiles. In 1953, the CIA began to station officers at the American Embassy in Moscow.[41]

One report suggests that HUMINT was employed to monitor rocket engine test firings at one of the two missile development installations outside of Moscow. The report notes that 'during the period 1952–59 Western observers have heard the sounds of a substantial number of rocket engines being fired at [the installation]'. A detailed record of time and length of firings was kept. A map at the end of the report showed that the factory was less than two miles from the American *dacha* (country estate) – an easy listening-post.[42]

The pervasiveness of HUMINT does not end there. Diplomatic personnel was also used for covert collection. The value of the air attaché was defended in a memorandum to the JCS in 1957, claiming that he was needed to 'prepare target analysis and weapons effect analysis; to maintain the authoritative intelligence base for targeting and to direct the World-Wide Air Targets Material Program'. Furthermore, he had 'innocent administrative reasons' to conduct overflights and aerial photography. Although this memorandum does not explicitly address the case of the Soviet Union, it shows that the military components of the diplomatic corps, at least, were not beyond engaging in clandestine activities.[43]

Human resources are incredibly varied, which constitutes both handicap and benefit. Before satellite systems capable of overhearing and overlooking activities throughout the entire USSR were available, HUMINT was crucial for focusing the limited purview of technical means. It is probably easier for advanced technical collection systems to offset the drawbacks of HUMINT than to surpass its benefits.

RADAR AND SIGNAL INTELLIGENCE

The knowledge of the existence of the Kaputsin Yar missile test site led

directly to the installation of a radar facility near Samsun, Turkey, to monitor the activities of the site. Operational by summer 1955, the radar began tracking missiles once they had reached an altitude of 35–40 n.m., and then tracked them along their entire flight path supplying information on their general configuration, speed and thrust. The initial range of 1000 n.m. was extended in 1957 to cover distances of 3000–3500 n.m. The information proved so valuable that further sites were constructed in the Elburz mountains and near Meshed, Iran.[44] After the first ICBM tests, a radar installation came under construction in 1958 on one of the Aleutian Islands to monitor the test target sites.[45]

Radar was complemented by the most secretive of the clandestine means of collection: communications intelligence. The interception of radio and telegraph communications had demonstrated its value in the Second World War, and COMINT provided essential information on the number of failures among the ICBM tests. These, since they never passed the 35–40 mile altitude from where they could be tracked by radar, became quantifiable thanks to installations such as that at Peshawar, Pakistan. Operational in November 1959, this housed the 6937 Communications Group of the Air Force Security Service, which kept track of launchings from the new test location at Tyutaram and the Soviet atomic weapons test site at Semipalatinsk.[46]

Radar and COMINT, in combination with aerial photography from peripheral flights along the southern border of the USSR, produced some of the firmest evidence of the period. Even sceptics such as the journalist Stewart Alsop admitted that in terms of detecting tests from these known test sites the US was doing quite well.[47]

AERIAL PHOTOGRAPHY

The first thing most people probably think about in connection with aerial photography during the period of the missile gap is the downing of the U-2 piloted by Francis Gary Powers on 1 May 1960. Indeed, the U-2 was a major achievement in covert collection, but its role was not decisive in the estimation of ICBM levels. This was so for two reasons.

First, and most important is the fact that the U-2 could not, in the words of James Dick, provide 'negative' intelligence;[48] that is, it was not able to provide data that conclusively established the *absence* of ICBM sites. Overflights were a scarce resource to the intelligence community, and they could not systematically provide complete coverage of the USSR. The five areas they were directed at were 1) the Soviet bomber force; 2) the Soviet missile force; 3) the atomic energy program (i.e. determination of nuclear stockpiles); 4) the submarine programs; 5) air defense installations.[49] Prioritization of these objectives necessarily precludes

'search' missions for new installations in remote areas in any comprehensive way. It is possible that one of the few overflights between early 1958 and 1960 was a reconnaissance mission over the northern part of the Soviet Union.[50] At an NSC meeting on 12 February, the subject was apparently broached:

> General Goodpaster pointed out that an aerial reconnaissance mission in the North had been considered and approved, but had not been flown as a result of unfavourable [deleted]. This cannot be implemented until March. It is rated No. 1 priority.[51]

Given the surface area that could be photographed by one pass, 4000 paired shots of a 125-mile wide, 2,174-mile long strip, providing total coverage would seem virtually impossible with the resources that were available. According to Francis Gary Powers, the first mission that actually was planned to fly *across* the USSR was his own ill-fated one of 1 May 1960, from Peshawar to Bodo, Norway. Intended to go 'deeper into Russia than we had ever gone'[52], it was never completed.

The U-2 was thus most useful for positive identification of suspected sites, or for the acquisition of previously unknown details that emerged thanks to the high resolution of the pictures brought back from the overflights. Thus, for example, it confirmed Tyuratam as a missile test facility, a site that had previously drawn attention in COMINT and agent reports. An overflight in the middle of 1957 actually spotted an ICBM on its launch pad.[53]

The second reason why U-2 intelligence could not settle the differences between various forecasts of the Soviet ICBM force lies in the nature of photographic evidence. Aerial photographs are subject to considerable interpretation. A number of technical reasons can lie at the heart of differing interpretations; for example, the resolution may be fine for detection but not good enough for positive identification, at which point judgement and experience must be used. The number of subjective and objective factors entering into photoanalysis precludes complete certainty in the interpretation past a certain level of detail, even when taking into account the use of advanced photogrammatic techniques.[54]

Both of these limitations are of course equally applicable to aerial photography in general (although the first is greatly reduced in the case of satellite photography). Other sources of aerial photographs did exist before and in tandem with the U-2. Perimeter flights along the Soviet Union's borders had been carried out by British and American planes sine the 1940s, and they included occasional runs into Soviet airspace. The U-2 also engaged in regular perimeter flights along the Peshawar–Adana (Turkey) route.[55] Finally, as has been mentioned, tourists on commercial and other legal flights provided pictures and observations to

the American intelligence community.The Soviet government was, however, acutely aware of these activities and made sure that flight routes even to places which were accessible to visitors did not pass over territory with sensitive installations.[56] On balance it is clear that these sources did not contribute decisively to the assessment of the Soviet strategic ICBM threat.

SATELLITE RECONNAISSANCE

The American reconnaissance satellite program was inspired by several RAND Corporation studies and culminated in a contract award to Lockheed to develop Weapons System 117L in 1956. In November 1957, after the perception of a potential missile gap impressed upon American officials the importance of reliable intelligence on the status of Soviet missile programs, Lockheed's budget for WS-117L was quadrupled.[57] On 7 May 1958, Secretary of Defense McElroy could write to the President that

> Weapons System 117L . . . is feasible and has potential operational capability of providing current and reliable intelligence information. Need for this information will continue to become more critical as technological advances enable a potential enemy to bring into being offensive weapons with constantly increasing range and greater destructive power.[58]

The initial schedule for WS-117L foresaw launches of the first Thor–Agena (later named Discoverer) vehicles in November 1958. Officially these were to carry no reconnaissance equipment, but were to orbit over the USSR. The first Atlas–Agena vehicles (Sentry, later named SAMOS) on the other hand, were to carry reconnaissance equipment but were not to orbit over Russia. Starting in May 1960, Atlas–Agena vehicles were to orbit over the Soviet Union equipped with reconnaissance equipment.[59]

By November, WS-117L officially consisted of Discoverer, SAMOS and MIDAS, although these names were not adopted until later. The two important systems for our purposes are Discoverer and SAMOS, MIDAS being an infra-red-sensing early-warning satellite.[60] Discoverer and SAMOS differed in several ways. The first was a 'close look' system; it was launched into a low orbit and equipped with a recoverable film capsule to enable it to take detailed pictures of Soviet installations. SAMOS on the other hand was an 'area survey' system, using a film-scanning method which converted the pictures taken into electronic signals and then transmitted the images to ground stations. It was placed in a higher orbit than Discoverer and provided comprehensive coverage

of the Soviet land mass. What it gained in coverage, it gave up in resolution; so that ideally the two systems would work in tandem.[61]

The actual launches varied somewhat from the anticipated schedule. Between the launch of Discoverer 1 on 28 February 1959 and Discoverer 38 on 27 February 1962, a total of 12 capsules were recovered successfully. The capsules were ejected anywhere from 1.11 days to 4.08 days after launch and completed one orbit in approximately 95 minutes. The first capsules were recovered in August 1960 from Discoverer 13 and 14, the latter being the first successful mid-air recovery.[62] According to Richelson, the pictures from this recovery were 'dark and of poor quality'.[63] Indeed, if any significant intelligence was gleaned from these capsules it was not evident in the NIEs over the following year. Six more capsules were recovered before the drastic downward revisions of NIE 11–8/1–61, two of them within a month before the date that estimate was issued. Two of the remaining four, Discoverer 17 and 18, recovered in November and December of 1960, should have been reflected in earlier NIEs had they contained pathbreaking new ICBM intelligence. Furthermore it is unlikely that pictures of the Soviet Union in November and December could have successfully revealed the entire land mass.[64]

This leaves the two capsules from Discoverer 25 and 26 in June and July 1961 as potential sources of what was considered a 'critical intelligence breakthrough'.[65] Given what has been said regarding the ambiguity that can enter photograph interpretation, such a claim already becomes tenuous. Most of all, however, first-rate photographic intelligence from a satellite would strip *current* ICBM launcher figures of their ambiguity; NIE 11–8/1–61, however, did not have this effect, instead it lowered projections of *future* figures, indicating that the information received pertained to predictors such as capabilities and intentions. Therefore it seems unlikely that two film capsules could have had the effect on NIEs that was in fact observed.

The same argument extends to the SAMOS program. Here, only SAMOS 2 was placed into orbit before the critical estimates; launched on 31 January 1961, it was placed into a orbit with a perigee of 474km and an apogee of 557km. It remained operational for about a month, orbiting the earth every 94.97 minutes. It is contended that it may have produced up to 1000 images of the Soviet Union, and that photo analysis explains the delay of eight months before the information was reflected in the NIE.[66] Opinions diverge, however, on whether or not SAMOS provided useful information, some contending that with a resolution of 20 feet its images would be militarily significant, while others claim that the quality of the pictures was so poor the program was a failure.[67]

CONCLUSION

The distinction between capability and intention which was prominent in the public debate over the National Estimates is valuable for rhetorical and perhaps even analytical purposes. On the one hand, as more hard data become available, intentions may become clearer; on the other hand, and more significantly, in a fledgeling program such as the Soviet ICBM effort, intentions become easier to determine as the program proceeds. Furthermore, intentions may to some degree capture the idea of comparison with one's own forces, for as a domestic response to the actions of the adversary is shaped this will have to be taken into account in trying to evaluate the likely courses of action of the adversary. Thus a shift to intentions may represent at least a partial shift to net assessment.

The more important distinction for the present purposes is, however, that between accomplishments and predictions. This is the issue on which the discrepancies in the National Estimates hinged. As long as uncertainty existed regarding the accomplishments of the Soviets, predictions were doubly uncertain. The proposition that there may have been an information gap, a phenomenon endemic to the development cycle of new technologies, in the case of the Soviet ICBM program is made by Prados.[68] The gist of the argument is that there is a period between pure scientific research and deployment of a system where it is particularly hard for enemy intelligence to determine the accomplishments of the program. This may have been the case during the hiatus in testing between 1960 and 1961. Since no new information was available on the progress of the Soviet program, Air Force Intelligence was able to argue that the Soviets had successfully developed their first-generation ICBM. The importance of determining present accomplishments in order to predict with at least some hope for success future capabilities and intentions is thus clear.

Is the threat of an information gap on the wane? Modern satellites that overhear millions of communications each hour have certainly narrowed the information gap. Intelligence sources can now confidently say that no new Soviet weapon tests come as a surprise to the United States.[69] Yet weapon systems introduced in the last 20 years have had few fundamental changes. With the advent of technologies, such as those envisaged in the Strategic Defense Initiative, will we have the ability to determine the accomplishments in such innovative technologies as X-ray laser and miniature kinetic energy weapons mounted on mobile, hard-to-find launchers? If we cannot determine accomplishments with some degree of accuracy, we shall again be faced with the dilemma of having to calculate capabilities and intentions from an insufficient inventory of facts.

NOTES

1. Canadian-United States Intelligence Conference, A.C.A.I. 46 'Soviet Capabilities and Probable Courses of Action Against North America in a Major War Commencing During the Period 1 July 1958 to 30 June 1959 (C)', prepared during Conference 13–17 January 1958 [DDRS (80) 169B].
2. Walter Laqueur, *A World Of Secrets* (New York: Basic Books, 1985) p.147.
3. John Prados, *Analysis, Organization and Politics: The Case of National Intelligence Estimates on Soviet Strategic Forces 1945–1975*, Volume 1; (Columbia University: Doctoral Dissertation, 1982) p.198 (henceforth referred to as Dissertation).
4. 'Interpretation' has to be construed somewhat narrowly in this paper; there is no easily identifiable analytic dividing line between interpretation of the intelligence that goes into an estimate and interpretation of the estimate itself.
5. CIA, 'A Summary of Soviet Guided Missile Intelligence', US/UK GM4–52, 20 July 1953 [DDRS (75)5-I], pp. A68-69K (henceforth referred to as GM4–52).
6. Prados, Dissertation, pp. 88–89.
7. CIA, 'Soviet Capabilities and Probable Courses of Action Through Mid-1959', NIE 11–4–54, 28 August 1954 [DDRS (81) 283A], p.58 fn.
8. CIA, 'Soviet Capabilities and Probable Soviet Courses of Action Through 1960', NIE 11–3–55, 17 May 1955 [DDRS (78) 22B] p.25.
9. No information available for NIEs from 1956.
10. CIA, 'Main Trends in Soviet Capabilities and Policies 1957–1962', NIE 11–4–57, 12 November 1957 [DDRS (79) 128A] p.27.
11. Prados, Dissertation, p.163.
12. NIE 11–4–57, p.27.
13. Memorandum from the Secretary of Defense, Robert McNamara to the President, 'The Missile Gap Controversy', 4 March 1963 [DDRS (79) 264B].
14. John Prados, *The Soviet Estimate* (New York: The Dial Press, 1982), table, p.89.
15. Ibid., p.79. Prados, Dissertation, p.163–65. Francis Gary Powers, *Operation Overflight* (New York: Holt, Rinehart and Winston, 1970) p.374.
16. McNamara–Kennedy memo.
17. Ibid.
18. Memorandum from Special Assistant Lawrence McQuade to Asst. Sec. of Defense, ISA, 'But Where Did The Missile Gap Go?', 31 May 1963 [DDRS (79) 264A].
19. Ibid.
20. Laqueur, p.150. Prados, Dissertation, p.201. Jeffrey Richelson, 'The Keyhole Satellite Program', (*Journal of Strategic Studies*, Vol.7, No.2, June 1984), p.128. In particular, it is unlikely that Penkovskiy provided any information that helped in this estimate. Penkovskiy did not make contact with the British until 20 April 1961. The three rolls of microfilm which apparently were a watershed in missile intelligence were not provided until May. Oleg Penkovskiy, *The Penkovskiy Papers* (Garden City: Doubleday 1965). See also Prados, *The Soviet Estimate*, p.116.
21. Quoted in Gerald Steinberg, *Satellite Reconnaissance; The Role of Informal Bargaining* (New York: Praeger Publishers, 1983), p.49, note, from *1961 Military Posture Briefings* (House Armed Services Committee Hearings 1961, 87th Congress, No.9, pp. 645–47).
22. Prados, Dissertation, pp. 214–15.
23. McQuade–Nitze Memo, 'But Where Did The Missile Gap Go?'
24. Richelson, p.127. Laqueur, p.151.
25. Prados, *The Soviet Estimate*, p.116.
26. McQuade–Nitze Memo, 'But Where Did The Missile Gap Go?'
27. GM 4–52, p.H9.
28. McQuade–Nitze Memo, 'But Where Did The Missile Gap Go?'
29. Prados, Dissertation, p.181 ff.
30. James C. Dick, 'The Strategic Arms Race, 1957–61: Who Opened A Missile Gap?' *Journal of Politics*, Vol.34, No.4 (November 1972), p.1093.

31. NIE 11–3–55, p.12.
32. NIE 11–4–57, p.15.
33. NIE 11–3–55, p.12.
34. Ibid.
35. GM 4–52, esp. p.H8.
36. Laqueur, p.153.
37. Ibid.
38. Ibid. pp. 42–48.
39. GM 4–52.
40. Prados, *The Soviet Estimate*, p.57. Laqueur, p.25, 143. William Hood, *Mole* (New York: Ballantine Books, 1982).
41. Prados, *The Soviet Estimate*, p.25.
42. CIA, OSI–C–RA/60–2, 'Scientific Research Institute and Experimental Factory 88 for Guided Missile Development, Moskva–Kaliningrad' 4 March 1960, [DDRS (79) 234C].
43. Memorandum to the Chairman, JCS, from Richard Collins, Deputy Director for Intelligence, Joint Staff, 'The Value of the Military Attaché System', 31 May 1957.
44. Dick, p.1067. Prados, *The Soviet Estimate*, pp. 35–36.
45. Prados, *The Soviet Estimate*, p.103.
46. Ibid.
47. Dick, p.1067.
48. Ibid., p.1074.
49. Allen Dulles, 'Statement For The Senate Foreign Relations Committee', 31 May 1960, [DDRS (79) 231B].
50. Powers suggests that only few missions were flown during this period; see Powers, p.374. On 10 July 1958 the U-2 was grounded after two pilots were killed in accidents in short succession; see Prados, Dissertation, p.165.
51. White House, Memorandum For The Record, 12 February 1959, National Security Council Meeting, 12 February 1959. [DDRS (81) 622A].
52. Powers, p.73. According to Dick, only 30 overflights were made in total, see Dick, p.1073.
53. Prados, Dissertation, pp. 94–6.
54. 'Problems of Photographic Imagery Analysis', 26 February 1968, [DDRS (81) 13B].
55. Prados, *The Soviet Estimate*, pp. 29–31. Powers, p.47.
56. Penkovskiy, p.175.
57. Anthony Kenden, 'U.S. Reconnaissance Satellite Programmes', *Spaceflight*, Vol.20, No.7 (July 1978), pp. 243–4.
58. Letter to the President from Secretary McElroy, 7 May 1958, [DDRS (83) 132].
59. 'Advanced Reconnaissance Satellite Schedule Through CY1960', 30 June 1958 [DDRS (83) 134].
60. Kenden, p.244.
61. Ibid.
62. Ibid., table p.245.
63. Richelson, p.127.
64. Kenden, table p.245.
65. McQuade–Nitze Memo, *'But Where Did the Missile Gap Go?'*
66. Kenden, p.247, table, p.248. Prados, Dissertation, p.210.
67. Richelson, p.128.
68. Prados, Dissertation, p.220ff.
69. David Hafenmeister, Joseph J. Roman and Kosta Tsipis, 'The Verification of Compliance With Arms Control Agreements', *Scientific American*, Vol.252, No.3, March 1985, p.39.