Great Historical Events That Were Significantly Affected by the Weather: 5, Some Meteorological Events of the Crimean War and Their Consequences

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Abstract

In November 1854, in an early phase of the Crimean War (September 1854–February 1856), two meteorological events occurred that had important effects. The first was an intense fog on the 5th, and the second an unusually violent storm on the 14th.

It so happened that the Russians launched their first major assault on the Allies (British, French, and Turkish forces) in the early hours of the 5th, without foreseeing the formation of fog. Forty thousand Russian troops attacked the Mt. Inkerman area of the Crimea, which was defended by a small British force of 3000. The fog greatly helped the Russians conceal the start of the attack from the Allies until they were at close range to the British. But the fog “assisted” the British, too, insofar as it made the Allies fail to realize the multitude of the Russian force. This failure helped the British keep up their fighting morale until a few hours later when reinforcements, predominantly French, brought about a turn in the battle’s tide. The great losses on both sides of the front led to a reduction in warlike operations for some time.

On the 14th an unusually intense storm crossed the Black Sea-Crimea area causing heavy losses and damage to the Allied navies and much suffering to the troops on land. According to British ship reports, the wind reached force 11 on the Beaufort scale (103–120 km/h). The British lost 21 ships or vessels and additional ones were dismasted; the French lost 16, including the battleship Henri IV, the “pride of the French Navy”; the Russians’ losses were light. The great losses of the Allies (ammunition, warm clothing, food, fodder, etc., in the ships) and the suffering of their land forces resulted in a notable reduction in fighting activities for some weeks. The loss of the battleship Henri IV prompted the French Minister of War to ask Le Verrier, the great French astronomer, to institute an inquiry to determine if the approach of the storm could have been foreshadowed and the Navy warned in time. This inquiry led to a significant leap in the development of the synoptic weather reporting network.

The present authors have consulted unpublished logbooks of 10 British ships and republish the logbook of a Russian battleship, little-known in the West. Other original, unpublished material includes the British Commander-in-Chief’s report on naval losses through the storm in the Balaklava area.

1. Antecedent events of the war

After the Grand Armée’s defeat and Napoleon’s final downfall in 1815, Russia had no reason to fear a military attack by France; France was exhausted from the protracted Napoleonic wars. Imperial Russia maintained generally friendly relations with Prussia and much the same applied in regard to Austria. In fact, in 1849 a Russian army helped preserve the unity of the Austro-Hungarian Empire against the rebellious Hungarians. Some friction developed between the two empires before the outbreak of the Crimean War, but it did not lead to an armed conflict between them. The only quarter in the west where Russia could expect (and did have) trouble was the Polish Kingdom. But since the Congress of Vienna of 1815 Poland was linked in a kind of union with Imperial Russia and any Polish insurgency was in all probability not considered a grave menace. Thus Imperial Russia felt secure from the west and the southwest.

With the accession in 1825 of the young Tsar Nicholas I (ruled 1825–55), a most self-centered and ambitious autocrat, the security in the west ushered in a new period of territorial expansion of Russia in other directions, especially in the east and the southeast. During Nicholas’s rule, parts of Persia and areas in the Caucasus and in the Far East, along the border with China², were annexed by Russia.


2 In the Amur River region. Communist China’s claims against Soviet Russia for the return of these areas have been frequently in the news over the past 15 years.
The direction toward which Nicholas would also have liked to extend his way was the south, into Turkey and the Balkans, much of the latter being under Ottoman rule at the time. Actually, Imperial Russia’s aspirations to bring these areas into its sphere of influence go back to Catherine the Great (ruled 1762–95), who was particularly interested in the reestablishment of the Byzantine Empire (under Russian tutelage, of course), which would have included Constantinople as its capital as in the past; the reestablishment of the Byzantine Empire would naturally have meant the dismemberment of the Ottoman Empire. The general area of Constantinople was considered vital to Russia for control of access to the Black Sea; further, Constantinople was a most important center of Orthodox Christianity, whose self-avowed leader Russia professed to be. Nicholas’s aspirations were opposed not only by the Ottoman Empire, but also by such western powers as Britain and France, especially the former, which had active interests in the Mediterranean, the Levant, and the route to India. In an attempt to move toward the materialization of his ambitions, Nicholas took two major steps. First, in May 1853 he advanced the demand for the right of “protecting” the citizens of Orthodox persuasion of the Ottoman Empire; this was but a poorly disguised imperialistic demand. Second, in July of the same year, Russia invaded and occupied the so-called Danubian Principalities (Moldavia and Wallachia, which united a few years later to form the “Old,” pre-World War I Rumania), which were then under Turkish control. As a warning to Russia, a British naval squadron put in at Constantinople in September (1853). The British ships did not enter the Black Sea as yet, for, under the terms of the London Convention of 1841, no foreign warships were permitted in the Black Sea so long as Turkey was at peace. In retaliation for the occupation of the Danubian Principalities, Turkey declared war on Russia in October and immediately began an offensive. In January 1854, at a time when the Ottoman Empire was at war, British and French warships cruised into the Black Sea to protect Turkish transports, and in March of the same year the two western powers declared war on Russia. Thus Nicholas’s empire had to face an alliance of Britain, France, and Turkey (troops of the Kingdom of Sardinia joined in January 1855).

The actual landing of Allied forces on Crimean soil took place in September 1854. With this began the Crimean War (on Crimean soil proper) that lasted until February 1856. The Allied forces comprised 27,000 British, 25,000 French, and 8,000 Turkish troops. The landing was unopposed. At the time of the landing of the Allies, the Russian army of the Crimea counted 50,000–60,000 troops (Seton-Watson, 1967, p. 325) and was thus possibly slightly inferior in numbers. (It was certainly inferior in weaponry and training compared with the Allies.) Since the Tsar could not be sure where the Allies would strike, a large Russian army (including some of Russia’s best-trained units) was kept in the Gulf of Finland area, protecting the approaches to St. Petersburg. Another large army was pinned down in the Danubian Principalities. Well before the time of the Allied landing, Gen. Paskevich, the Russian Commander-in-Chief, urged the Tsar to withdraw the forces from the Principalities, but Nicholas would not agree to that. The transfer of the latter and other troops to the Crimea was a painfully slow process. In the beginning of the 1850s Russia had but one major railway line (Blackwell, 1968, p. 318)—the line from St. Petersburg to Moscow—and nothing south of Moscow, the distance from Moscow to the Crimea amounting to 1500 km. Consequently, the reinforcements from the Principalities and from southern Russia had to be moved by carts and wagons.

The first major battle of the Crimean War was fought on 20 September 1854 in the area of the Alma River (Battle of the Alma). Despite the favorable topographic position of the Russians, the combat ended in a major victory for the Allies. The next major battle developed on 25 October at Balaklava. The senseless conduct of this battle (as of the whole of the Crimean War—on both sides of the front) caused heavy losses in life, especially to the British. The battle will be remembered for the “Charge of the (British) Light Brigade,” immortalized by Tennyson’s famous poem.

For an overview of the course of the Crimean War in a volume that is likely to be available in many places, see the 1967 edition of *Encyclopedia Britannica, 6*, 759–762.

2. Major meteorological events of the war

The two most outstanding meteorological events of the war took place in close succession in November 1854. The first was an intense fog that developed early on the morning of the 5th, just when the Russians were launching their first major offensive. By assembling a large force, the Russian Command hoped to drive back the Allies and relieve the pressure of the siege on Sebastopol, the principal Russian base in the Crimea. The next and by far the more important meteorological event was the passage on 14 November of an unusually violent storm in the Black Sea-Crimea area that caused heavy damage and losses.

1 See Catherine the Great’s letter to the Habsburg Emperor Joseph II, dated 21 September (New Style) 1782, where the Byzantine Empire is referred to under the designation “ancienne Monarchie grecque” (the letter is in French). This document is reproduced in Herrmann (1860, see especially p. 463). See also the dispatch of Count von Görtz, the Prussian Ambassador to St. Petersburg, to his king, Frederick the Great, dated 24 August 1784. This dispatch is reproduced in Zinkeisen (1859, see especially p. 939). Catherine’s plans involved other changes as well in southeastern Europe—at the expense of the Ottoman Empire.
to the Allied navies (and, to a lesser extent, to the Russians), battleships and supply vessels alike. If we recall that the communications of the Allies depended entirely on sea transport from faraway home bases (roughly 4000 km distant for the British and the French), the military significance of the blow delivered by the storm will be appreciated. But not only the navies were hit: Great suffering was sustained by the forces on land, including the large numbers of wounded and sick troops whose plight will be remembered in association with Florence Nightingale’s name.

The fog had a serious effect on the course of the battle of 5 November (see next section). Quite unexpectedly, it helped the Russians conceal their lineup and the start of their assault. In contrast, the tempest of 14 November (see Section 4) was an event by itself when no military operations were in progress. As is well known, this storm had significant consequences for the development of synoptic meteorology and weather forecasting. Gravely stricken by the naval losses and especially by that of the Battleship Henri IV, the “pride of the French Navy,” Marshal Vaillant, the scientifically minded French Minister of War, asked Urbain-Jean-Joseph Le Verrier (1811–77), the great French astronomer, to undertake an investigation to determine if the path of the storm could have been foreshadowed (Le Verrier, 1855b, p. 1197) and the Navy warned in time. Le Verrier, who was at the time an internationally respected scientist, contacted a large number of scientific institutions, mostly in Europe, asking for details of the motion and characteristics of the storm (Le Verrier, 1855a). He received replies from some 250 organizations and found that, in his opinion and in that of the meteorologists associated with him, the path of the tempest could have been estimated and the Navy warned in time. These findings were followed up by the establishment of an international network of synoptic weather stations, a process in which Le Verrier had a central initiative and role (Le Verrier, 1855a and b). The practical value of this network was made possible by the then-recent invention of the electric telegraph.

The great consequences of the storm for the development of synoptic and dynamic meteorology are described in some detail in a text by Hildebrandsson and Teisserenc de Bort (1898). More recently, Landsberg (1954) published a paper on the subject on the occasion of the ‘centenary’ of the tempest; another, more recent paper was prepared by Detwiller (1978) for the 100th anniversary of Le Verrier’s death in 1977.

Since the consequences of the 14 November 1854 Crimean storm for meteorology are discussed in the aforementioned literature, we shall deal only with a description of the storm based on records so far unexploited and preserved in archives, and on some data published in Russian literature.

### 3. The fog of the battle of Mt. Inkerman, 5 November 1854

Von Todleben (1864, p. 528), the great engineering colonel and later general of the Russian forces in the Crimean War, tells us that after the landing of the Allies (about mid-September 1854), Prince Menshikov, Commander-in-Chief of the Russian army in the Crimean theater of war, made strenuous efforts to obtain reinforcements in order to lift the siege of Sebastopol. The Allied pressure on this base was by no means reduced by the Russian victory at Balaklava toward the end of October. The Prince’s efforts bore fruit, but not before five to six weeks passed from the time of the invasion. We have mentioned in the foregoing section that in the absence of railway lines in southern Russia the reinforcements had to be transported in carts and wagons. Von Todleben (1864, p. 441) notes that the Allies could obtain reinforcements by their steamships (from their faraway bases) faster than the Russians, whose ‘highways’ were poor—the state of the roads made worse by the ‘advanced’ season. It appears that by 4 November the Russians received some 45 000 fresh troops (Tyrrell, 1855–58, p. 344), and that the Prince left very little time between their arrival and the start of the assault on Mt. Inkerman.

On learning of the arrival of the massive Russian reinforcements, Lord Raglan, Commander-in-Chief of the British field army, strengthened his units in the Balaklava area, where his main ports of supply were situated. This step is, perhaps, understandable, for the fighting capacity and, indeed, the survival of his force depended critically on secure ports. However, since the magnitude of his army was not commensurate with the tasks at hand, strengthening of the British positions in one area necessarily entailed weakening the positions elsewhere. The weakest of these was in the area called Mt. Inkerman (see Fig. 1) by the Allies, and Cossack Mountain by the Russians (Seaton, 1977, p. 162), which was manned by no more than

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1. One of the greatest scientific contributions of Le Verrier was his theoretical prediction of the existence and position of a planet beyond the planet Uranus. His computations were based on disturbances by an unknown body on the motion of Uranus. On 18 September 1846 Le Verrier wrote a letter to the astronomer Johann Gottfried Galle in Berlin concerning the unknown planet and its computed positions. The planet was located at first attempt by Galle. The newly discovered planet was christened Neptune.

2. The French meteorologist Teisserenc de Bort’s (1855–1913) name will be remembered in connection with his discovery in 1898 of the stratosphere; Hildebrandsson (1838–1925) was Professor of Meteorology and Director of the Meteorological Observatory at the University of Uppsala, Sweden.

3. The fog of the battle of Mt. Inkerman, 5 November 1854

4. Presumably, by the phrase ‘advanced season’ it is meant that the autumn rains turned the roads muddy and made them hard to pass.

5. The fog of the battle of Mt. Inkerman, 5 November 1854

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FIG. 1. Map of southwestern Crimea showing the locations of Sebastopol (the principal Russian base of the Peninsula), Balaklava (the principal port of the British forces), and Eupatoria (Allied base and scene of landing of the Allied forces about mid-September 1854); the French headquarters were at Kamiesh, just inland from Kamiesh Bay. Insert shows the Crimean Peninsula.

3000 troops. An appeal to the French before the battle was of no avail, as the French themselves were awaiting further contingents (Kinglake, 1875, pp. 44-45).

Because of the smallness of the Allied forces in the Mount area, the Russian High Command’s choice naturally fell on the Mount, despite the difficulties of terrain and despite the fact that some of the Russian generals directly involved in the assault had little familiarity with the ground. The Russian assault forces consisted of two army corps commanded, respectively, by Generals Pavlov and Soimonov, who, on the day preceding the attack (confidently expected by the Russians to deal a deadly blow on the Allies), were placed under the command of General Dannenberg. The two corps comprised about 40 000 men (Kinglake, 1875, p. 50), i.e., about 10 times as many as the British force defending the position. A third Russian corps, counting about 22 000 men and commanded by Prince Gorchakov, was located east of the Mount. This corps was to simulate a diversionary attack aimed at tying down a French division and join the aforementioned two corps after their confidently expected success.

The Russians took great care to conceal their preparations and movements in the offensive. In this they were unexpectedly and greatly aided by a heavy mist that developed before dawn on 5 November.

On 4 November, 3 h before dark, the British took, as was their custom, a “last-look-of-the-day” at the Russian positions. True, the day was rainy (Kinglake, 1875, p. 62), but visibility was not substantially impaired. Nothing untoward was noted and it was therefore taken for granted that a quiet night was in store. During the night the protracted rumble of what were thought to be heavy vehicles (in fact, they were mostly gun-carriages) was heard; church bells

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1 Menshikov left no time for reconnaissance and the only good map of the area arrived from St. Petersburg after the battle (see Curtiss (1965, p. 335)).

2 In order to avoid offending the nobility, the Taar would not replace the weak Prince Menshikov, so he delegated power to Dannenberg under the Prince’s nominal command. Dannenberg’s victory record was poor (see Gibbs (1960, p. 230)). For further interesting details, see Seaton (1977, pp. 160-163).

3 Kinglake’s figures are based on von Todleben’s (1864, pp. 451-452 and p. 454) data, which do not include the number of artillery men and sappers. Estimates of these were added by Kinglake to von Todleben’s data.
in nearby Sebastopol rang late in the evening and very early in the morning, but all this was not totally out of the ordinary, as 5 November was a Sunday.

During the second part of the night, a heavy mist developed in the Mount area and in the adjacent valleys. The Russian forces began to take up positions about two hours after midnight, but because of the mist, the night, and the silence observed by the Russians, the British outposts found nothing suspicious to report. Earlier we pointed out that the British were wont to take a look at the Russian lines shortly before dark; also it was a custom with them that an officer of the Quarter-Master’s Department inspect the British lines about an hour before daybreak. The visibility was now greatly reduced by the mist, but since the Russians advanced so silently, the inspecting officer reported “the night was more than usually quiet” (Kinglake, 1875, p. 65). At about half-past four, pickets of the French division placed close to the unseen corps of Prince Gorchakov indicated that the Prince’s corps were in motion (Nolan, 1857, p. 587), but as nothing was actually seen, the reports went unheeded.

Kinglake (1875, pp. 117–118), the British historian of the Crimean War (the first edition of the ‘history’ was in eight volumes), points out that so quiet was Gen. Soimonov’s march to Mt. Inkerman; so obscure to the eye were his troops in their grey capotes; and so well had the night, the mist, and the drizzle favored his approach, that even at daylight, his silent grey line still glided on for a while unseen and unheard by the British. Yet he had now come within hailing distance of the ledge of the hill (“Shell Hill”) where a chain of British sentries was posted. Elsewhere (p. 119) he writes: “Still, the keenest observer, that night, could see nothing worth mark through a curtain of mist and drizzling rain.” Very soon, however, about 7 a.m., the small British force was subjected to tremendous fire from the advancing but unseen Russians (Tyrrell, 1855–58, p. 345). Three lines from an unnamed poem by an unnamed poet quoted by Nolan (1857, p. 586) neatly sum up the situation of the hour of attack:

The thick mist allow’d
Nought to be seen save the artillery’s flame,
Which arch’d the horizon like a fiery cloud.

Despite the fact that Gen. Soimonov chose to disobey his new Commander’s (Gen. Dannenberg) orders, the initial surprise of the Russian attack, decisively aided by the mist, was so great that before long the Russians were able to capture three-fourths of Mt. Inkerman. However, the fog proved a double-edged sword. It helped the Russians at first, but it helped the British, too, insofar as it misled them in regard to the strength of the assault force (40 000 vs. 3000 at the beginning). Erroneously thinking that they were facing small units, they fought without being daunted by the unseen multitudes (Kinglake, 1875, p. 477).

Because of the fog there was no question of fighting in formation as a cohesive force. Owing to the limited visibility the bayonet was the chief weapon, along with anything else that came to hand. It was a confused struggle of detached crowds, men grappling hand to throat, hardly recognizing one another beneath the dense fog (Nolan, 1857, p. 588). W. H. Russell, war correspondent on behalf of the London Times and one of the first war correspondents in history, recorded the following lines (excerpted from his extensive dispatches) on the Inkerman Battle: “No one, however placed, could have witnessed even a small portion of doings of this eventful day, for the vapours, fog and drizzling mist obscured the ground to such an extent as to render it impossible to see what was going on at a distance of a few yards” (Tyrrell, 1855–58, p. 346). He adds a few lines later: “Our [meaning the British] generals could not see where the enemy were, from what side they were coming, nor where they were coming to.” Indeed, the mist turned the Battle of Inkerman from a “generals’ battle” into a “soldiers’ battle. The fog is indicated in the background of Fig. 2, the original of which was engraved by the British artist G. Greatbach. (Actually, the engraving intends to show the fall of the British General Cathcart.)

Shortly after the beginning of the attack, the 3000 British were reinforced by 5000 British troops and, a little later, by 6000 French. Thus in the second part of the battle the Allies had in the Mount area a total of 14 000 men, minus casualties, vs. 40 000 Russians, minus casualties. Despite the great numerical inferiority of the Allies on the scene, the battle ended in an Allied victory, due to no little extent to the French.

The battle caused heavy losses to the Russians and, in relative terms, very heavy losses to the British. The latter lost about 2600 in killed—including four generals—wounded, and missing, out of a total of 8000; the French lost 1700 out of 6000 (Tyrrell, 1855–58, p. 350). Figures for the Russian losses are controversial. Von Todleben (1864, p. 489) puts them at about 11 500, but possibly their losses were even higher. While the Russians admitted (von Todleben, 1864, pp. 492–494) that the battle was a grave defeat for them (and for their expectations), it had a restraining influence on the Allies: They realized that the Russians were able to put up a major offensive. In fact, the plan of a French assault on some formidable fortresses of Sebastopol, which was to be launched shortly after 5 November, was abandoned, and altogether the Allied fire on Russian positions was kept at a low level for some days. Then came the next meteorological blow, viz., the great storm of

10 His reports of the conduct of the Crimean War by the British caused a great stir in Britain and much criticism of the Government and the military commands. The related critical editorials of The Times earned it the epithet “The Thunderer.”
14 November 1854. It hit all the belligerents, but first and foremost the Allies.

4. The storm of 14 November 1854

November 1854 was the first late autumn month for the Allied fleets in Crimean waters. The weather was stormy and menacing, arousing concern for the safety of the ships, for their destruction by stormy weather would have doomed the Allies' invasion. The night of 10/11 November was especially boisterous (de Bazancourt, 1856a, pp. 348-352), so much so that it was feared that the anchor cables of the ships would be snapped by the sea and the ships dashed onto the beaches.

Preventive action became imperative, and by the morning of the 11th Counter-Admiral Bouët-Willaumez, Chief of Staff of the French fleet, worked out a plan according to which the French and the British would keep but a total of 14 warships, equal in number to that of the Russian warships held in the area, and a minimum number of supply and service vessels; all other warships and vessels would be sent back to the Bosphorous area for "wintering" and called back only in the case of need.

The plan was approved at once by Admiral Hamelin, First Admiral of the French fleet, and a copy of the plan was forwarded to the British. On the 13th the Counter-Admiral proceeded to Kamiesh (see Fig. 1), headquarters of the French, where the plan was authorized by Gen. Canrobert, Commander-in-Chief of the French Expeditionary Force. Originally, Admiral Hamelin too intended to take part in the discussion, but the weather appeared so ominous that he felt he must remain at his command post. The next morning the great storm broke and it was not possible to put the plan into practice; the storm either destroyed or disabled a high fraction of the number of Allied ships and vessels. The scenario outlined by the Counter-Admiral on the 11th was played back by the reality of nature on the 14th.

As was stated previously, the weather of the 13th was ominous in the Crimean area of concern. It was a day of rain and wind (Kinglake, 1880, p. 160), but a calm set in in the evening. In the early morning of the next day a storm began to move in, travelling from the southwest toward the northeast (see estimated pressure charts and probable path of the storm in Landsberg, 1954, p. 352, and reproduced here as Fig. 3) at a speed of approximately 30 km/h (Niel, 1858, p. 101; Kinglake, 1880, p. 160). It appears that the most detailed observations of the storm in inshore waters, and especially of the effects of the storm, are found in logbooks of Russian and British ships. The observations include some or all of the following: wind direction and speed, barometric pressure, cloudi-
ness, precipitation, appearance of weather and state of the sea; in several cases notes were made on the effects of the tempest on the ships and on its disastrous or near-disastrous effects on other ships.

**a. Russian observations**

The Russian General von Todleben (1864, pp. 509–511), whose book we have quoted several times in this study, published a copy of the logbook of the Battleship *Grand Duke Constantine* (*GDC*) for the storm and this logbook is reproduced in Table 1. The observations give a few readings of the barometer though we have no details of the instrument, its calibration and exposure, and the corrections applied to its readings. As far as the effects of the storm on ships go, the *GDC* log is more detailed than the logs of British ships (see Section 4b). The original pressure readings are in inches of mercury and these we have converted.

### Table 1. Extract from the logbook of the Imperial Russian Battleship *Grand Duke Constantine* for 14 and part of 15 November 1854.

(Source: von Todleben, 1864, pp. 510–511.)

<table>
<thead>
<tr>
<th>Hour</th>
<th>Wind</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov. 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>01</td>
<td>SSW</td>
<td>Light wind. Gloomy weather. Slight rain.</td>
</tr>
<tr>
<td>05</td>
<td>SSE</td>
<td>Medium strong turbulent wind. Gloomy. Rain.</td>
</tr>
<tr>
<td>07</td>
<td>S</td>
<td>At 07 hrs a violent revolving storm moved in from the south accompanied by rain and hail. The Steamer <em>Elborus</em> and the BS <em>Empress Mary</em> and the Frigates <em>Medea</em> and <em>Kabul</em> were driven aground by the wind. Pressure 998.7 mb.</td>
</tr>
<tr>
<td>08</td>
<td>S</td>
<td>Pressure 1001.7 mb.</td>
</tr>
<tr>
<td>09</td>
<td>S</td>
<td>Violently turbulent wind. At 08.08 hrs the BS <em>GDC</em> lowered a second anchor. At 08.12 the BS <em>TA</em> orders the BS <em>Svatoslav</em> to drop an anchor. At 08.20 the wind blasts away the poop flag. At the same time a second enemy steamer is overpowered by the wind.</td>
</tr>
<tr>
<td>10</td>
<td>S</td>
<td>At 09.05 the storm rips away two sloops from the BS <em>Paris</em> and hurls them toward the rocks. At 09.40 the Steamer <em>Gromonossets</em> runs aground. At 09.43 the BS <em>GDC</em> is ordered to render assistance to the Steamer <em>Gromonossets</em>. At 09.30 the BS <em>GDC</em> cables that it is despatching now a launch with a spring anchor for the Steamer <em>Elborus</em>.</td>
</tr>
<tr>
<td>11</td>
<td>SSW to SW</td>
<td>At 10.30 all vessels are ordered to drop anchors. At 10.35 the wind veers to the west and the sea becomes hollow. At 10.45 the Steamer <em>Gromonossets</em> is afloat again. At 10.50 the Steamer <em>Chersonese</em> sends a distress signal.</td>
</tr>
<tr>
<td>12</td>
<td>WSW to W</td>
<td>Pressure 1007.5 mb.</td>
</tr>
<tr>
<td>13</td>
<td>W</td>
<td>Fiercely turbulent wind with a hollow sea from the west. Gloomy. Occasional rain and hail. At 12.10 the BS <em>TA</em> orders the Steamers <em>Vladimir</em> and <em>Krim</em> to proceed to the aid of the Steamer <em>Chersonese</em>.</td>
</tr>
<tr>
<td>14</td>
<td>WSW</td>
<td>At 13.15 the <em>Elborus</em> is afloat again but the Steamer <em>Grosnoy</em> issues a distress signal. At 13.20 the BS <em>TA</em> orders the Steamer <em>Bessarabia</em> to go the aid of <em>Grosnoy</em>. At 13.10 the <em>Grosnoy</em> signals that she hit rock.</td>
</tr>
<tr>
<td>16</td>
<td>WSW</td>
<td>At 15.10 the Steamer <em>Vladimir</em> pulls off a merchant vessel that was driven by the wind into the Steamer <em>Chersonese</em>. At 15.30 the Admiral signals his special appreciation of the <em>Vladimir</em>'s action and orders an extra portion of brandy to be given to each of the sailors. At 15.45 the Admiral orders a second extra portion of brandy to <em>Vladimir</em>'s crew.</td>
</tr>
<tr>
<td>20</td>
<td>WSW</td>
<td>Pressure 1012.5 mb.</td>
</tr>
<tr>
<td>21</td>
<td>WSW</td>
<td>Violently turbulent wind, hollow sea.</td>
</tr>
</tbody>
</table>

| Nov. 15 | | |
| 08 | WSW | Pressure 1023.4 mb. |

**Abbreviations:** BS = Battleship; *GDC* = *Grand Duke Constantine*; TA = Twelve Apostles (flagship of the Russian navy of the Crimea).
into millibars (mb). The report of rise in pressure from 07 to 08 h is not understood. Most of the British ships anchored in nearby areas, such as Balaklava, east-southeast of Sebastopol, and at the mouth of the River Katcha, north of the city, indicate that the minimum pressure occurred between 10 and 11 h, or, perhaps, about 11 h. It must be pointed out, however, that some of the British logs also show an early minimum. It is probably correct to say that in a highly turbulent low pressure system such as the 14 November 1854 tempest (both the Russian and British reports point to a high degree of turbulence of the wind), there may occur considerable fluctuations in pressure, e.g., in violent cloud down-drafts.

We have not been able to establish if all the Russian ship losses or wrecks, naval or civilian, are covered by the logbook of the GDC. But since the Russian fleet of the Crimea was numerically much smaller than that of the Allies, and since several of the Russian ships were anchored in Sebastopol Roadstead, which offered some shelter from the wind, and, finally, since the log of the GDC also records signals from the flagship Twelve Apostles to other ships even in cases where the GDC was not involved, the likelihood is that the GDC log covers the important cases, at the least. When these are compared with the losses of the Allies (see Sections 4b and c), the Russian losses appear relatively small.

The winds whipped up the sea so much that one of the large ships that the Russians had deliberately sunk a few weeks earlier to hinder entrance to Sebastopol's harbor was displaced and driven out of the mole. On the 17th, the Russians sank another vessel in its place (de Bazancourt, 1856b, p. 132, footnote). All the trenches along Sebastopol's defense lines were flooded and the drainage system constructed around the ammunition cellar proved inadequate (von Todleben, 1864, p. 508). Houses were unroofed and the vast metal sheets covering the naval storehouses of the base were partly carried away (Niel, 1858, p. 101). The unusual severity of the tempest is further evidenced by the fact that the trees of many years' growth standing on Sebastopol's quays were uprooted.

b. British observations

Logbooks of British ships that were in the Crimean War area are kept in the Public Record Office, Kew (just south of London).\textsuperscript{a} We have inspected the original logbooks of the following ships:

- H.M. Steam Vessel Bellerophon
- H.M. Vessel Spitfire
- H.M.S. Leander
- H.M.S. Trafalgar
- H.M.S. Sloop Niger
- H.M. Steam Vessel Sampson
- H.M.S. Retribution
- H.M.S. Tribune
- H.M.S. Triton
- H.M.S. Vesuvius

In Table 2 we reproduce most of the information provided by the logbooks of the Bellerophon, Leander, Retribution, and Sampson.

Landsberg (1954, Fig. 2, also p. 351) publishes a pressure chart for the tempest. Shown here as Fig. 3, it is for 10 h, 14 November 1854, when the tempest was at or near its height in the Crimean area. The chart is based on data gathered by the French meteorologist E. Liais, chief of the Service Météorologique International (at the Observatoire de Paris, and whose Director was Le Verrier). British ships anchored at Balaklava (Retribution), at the mouth of the River Katcha (Bellerophon, Sampson, and Trafalgar), and in the Eupatoria area in the north (Leander), agree in stating that at mid-morning the wind was from the southwest or close to that direction. This would suggest that the center of low pressure must have been to the northwest at the time, which would agree with the Landsberg-Liais chart. Most of the British ships give the lowest pressure between about 10 and 11 h or about 11 h.

The British ships are almost unanimous in giving a wind speed of force 11 on the Beaufort scale (an exception is H.M. Vessel Spitfire, which gives a force 12!) for the late morning hours. This would correspond to a wind of between 103 and 120 km/h, a value that is 20–40% higher than the value cited by Niel (1858, p. 101). The French General (later, Marshal) Niel quotes Keller, a hydrographic engineer to the French fleet, to the effect that the rate of displacement of the storm was approximately 30 km/h and that the maximum wind speed in the Eupatoria area was about 85 km/h. We believe that as far as wind speed is concerned, greater credence should be given to ship reports. A further pointer to a higher speed is the great destruction brought about by the wind. Incidentally, the log of H.M.S. Vesuvius notes at 09.50 h that "... the wind increased to a perfect hurricane."

We note in Fig. 3 that in the area stretching from Sebastopol to Eupatoria the horizontal pressure gradient over the sea must have been about 0.1 in of mercury, or about 3 mb, per, say, 25–30 km. Taking the air density \( \rho \) as \( 1.25 \times 10^{-3} \text{ g/cm}^3 \) and the Coriolis parameter \( f \) as \( 10^{-4} \text{ s} \), the geostrophic wind speed \( V \) would work out as

\[
V = \left( \frac{1}{\rho f} \right) \frac{\partial \rho}{\partial n} = 100 \text{ m/s},
\]

where \( \rho \) is pressure and \( n \) the unit normal vector to the isobars in the horizontal plane. Thus, on the aforesaid conditions, we arrive at a geostrophic wind speed of about 100 m/s or 360 km/h. If we reduce this value by, say, 40% to account for friction, the remaining velocity is still far too high. It thus appears that the Liais data lead to an unrealistically high horizontal pressure gradient.

\textsuperscript{a} They are stored under classmark ADM 53.
Table 2. Extracts from logbooks of British ships anchored in Crimean waters on 14 and part of 15 November 1854. Source: Original logbooks of British ships held in the Public Record Office at Kew, London, under classmark ADM 53.

<table>
<thead>
<tr>
<th>Hour (Nov. 14)</th>
<th>H.M.S. Leander (off Eupatoria)</th>
<th>H.M.S.V. Bellerophon (off mouth of River Katcha)</th>
<th>H.M.S.V. Sampson (off mouth of River Katcha)</th>
<th>H.M.S.F. Retribution (off Balaklava)</th>
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</thead>
<tbody>
<tr>
<td>01</td>
<td>NNW/3</td>
<td>SSW/4</td>
<td>S/2</td>
<td></td>
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<tr>
<td>03</td>
<td>ENE</td>
<td>EbyN/2–3 squally showers</td>
<td>SE/3</td>
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<tr>
<td>04</td>
<td>EbyN/3–4 1006.4</td>
<td>ESE/2</td>
<td>SE/2</td>
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<tr>
<td>05</td>
<td>/5</td>
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<tr>
<td>06</td>
<td>E 1005.8</td>
<td>S/5–6</td>
<td>SbyE/5 heavy squalls,</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>1002.4</td>
<td>heavy sea</td>
<td></td>
</tr>
<tr>
<td>07</td>
<td>EbyN/6 squall, high sea 1000.7</td>
<td>SSE to SSW/4–9 1007.5 (?)</td>
<td>S/7</td>
<td></td>
</tr>
<tr>
<td>08</td>
<td>S/6 wind shifts in heavy squall,</td>
<td>SbyE/6–9 becoming 9</td>
<td>SSW/9</td>
<td>SSW/8</td>
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<tr>
<td></td>
<td>rain</td>
<td></td>
<td>1002.4</td>
<td>1002.4</td>
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<tr>
<td>09</td>
<td>/7 sails blown away 999</td>
<td>ship struck by other ships 997.3</td>
<td>SWS/9</td>
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<td></td>
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<td></td>
<td>heavy squall,</td>
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<td></td>
<td></td>
<td></td>
<td>heavy sea</td>
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<tr>
<td>10</td>
<td>SW/9</td>
<td>SbyW/10 bowsprit bulwark carried away 995.6</td>
<td>SWS/10 guns overboard</td>
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<tr>
<td>11</td>
<td>WSW/11</td>
<td>WSW/11 993.9</td>
<td>SW/11</td>
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<td></td>
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<td></td>
<td>sea washes 2 guns away, heavy</td>
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<td></td>
<td></td>
<td></td>
<td>sea, ship labouring</td>
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<td>12</td>
<td>WNW to W 999</td>
<td>W to NW/11 1001.4</td>
<td>SW/10</td>
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<td></td>
<td>ship rolling heavily;</td>
<td></td>
<td>1012.5 (?)</td>
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<td></td>
<td>observe other ships in trouble</td>
<td></td>
<td>999</td>
<td></td>
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<td>13</td>
<td>W/10</td>
<td>SW/10</td>
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<td></td>
<td>ship rolling</td>
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<td>heavily;</td>
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<td></td>
<td>observe other ships in trouble</td>
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<tr>
<td>16</td>
<td>W/7 1009.1</td>
<td>SSW/9 1017.6</td>
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<td></td>
<td></td>
<td></td>
<td>now moderate</td>
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<td></td>
<td>heavy sea</td>
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<td></td>
<td></td>
<td></td>
<td>still breaking; lose anchor</td>
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<td>17</td>
<td></td>
<td></td>
<td>extra allowance of spirits</td>
<td></td>
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<td></td>
<td></td>
<td>issued</td>
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<tr>
<td>18</td>
<td>1014.2</td>
<td>S/6</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Henrik IV drifting broadside</td>
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<td></td>
<td>to shore</td>
<td></td>
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<tr>
<td>19</td>
<td></td>
<td></td>
<td>extra allowance of spirits</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>issued</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>W to S/6</td>
<td>SW/8 1021</td>
<td>WNW/9</td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th></th>
<th>H.M.S. Leander (off Eupatoria)</th>
<th>H.M.S.V. Bellerophon (off mouth of River Katcha)</th>
<th>H.M.S.V. Sampson (off mouth of River Katcha)</th>
<th>H.M.S.F. Retribution (off Balaklava)</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td></td>
<td>very heavy hail squalls</td>
<td></td>
<td>SW/9 heavy sea</td>
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<td>23</td>
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<td>(Nov. 15)</td>
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<td>00</td>
<td>WSW/7</td>
<td>SW by W/7</td>
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<tr>
<td></td>
<td>1019.3</td>
<td>1023.4</td>
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</tr>
<tr>
<td>01</td>
<td>WSW/6-7</td>
<td>WSW/6</td>
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<tr>
<td>02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>1022.7</td>
<td>daylight; observe a Turkish battleship on shore; Onshore 5 English and 5 French steamers</td>
<td>heavy swell from west</td>
<td></td>
</tr>
<tr>
<td>08</td>
<td>WSW/4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1021.7</td>
<td></td>
<td></td>
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</tbody>
</table>

In the line against any observation hour we give the wind direction and speed as “force” on the Beaufort scale; immediately below it we cite the atmospheric pressure where these items of information are recorded. H.M.S. = Her Majesty’s Ship, H.M.S.V. = Her Majesty’s Steam Vessel, H.M.S.F. = Her Majesty’s Steam Frigate. (Question marks against some of the observations were added by the authors.)

Some of the great damage inflicted on the British land and naval forces is summed up in a letter by Lord Raglan (it will be recalled from Section 3 that he was the Commander-in-Chief of the British Expeditionary Force to the Crimea) to the Duke of Newcastle, Britain’s Secretary of State for War. The original of this letter is preserved in the Public Record Office, Kew.¹³ The letter reads as follows:

Nr. Sevastopol
15th November 1854

His Grace
The Duke of Newcastle
My Lord Duke,

In my dispatch No. 102¹⁴ I stated that the weather was very bad. After sunset the rain ceased and the wind went down and until an hour before daylight yesterday morning it remained perfectly calm. Then there arose the most violent tempest I ever witnessed, attended with thunder and lightning, heavy rain, hail and later in the day snow and the damage it has associated is fearful.

The camp soon became in a dreadful state of mud, the tents were blown down and the sick as well as those who were fit for duty were exposed to the hurricane in all its violence and no remedy could be applied, for the roads were as nearly as possible impassable and a single horseman could hardly make his way in opposition to the wind. In one instance the horse of an orderly dragoon who was charged with a letter was blown down three times. There was no possibility of lighting the camp fires or of cooking provisions.

On the coast the consequences were very serious, as you will see by the accompanying copy of a letter from Captain Dacres, the senior officer of the Navy in Balaklava Harbor¹⁵, in which it is reported that of the vessels outside, the “Prince” steamer, the “Resolute”, “Kennilworth” and

¹⁴ In pencil is added “of the 13th Instant.”
¹⁵ Harbor is at this place in the letter spelt with an “o.”
"Wildwave" transports as well as the "Progress", "Wanderer" and "Malte" Commissariat ships have been lost with the greater portion of their crews, and that the "Pultowa" which had drifted into the harbour cannot, any more than its cargo, be saved.

Your Grace will also perceive that: the remaining ships in the roadstead, viz. the "Melbourne", "Pride of the Ocean", "Medora", "Lady Valliant", "Mereid", "Caduceus", and the Sir Robert Sale, HMS "Retribution" and "Vulcan" had held their anchors but all these with the exception of the two last had been under the necessity of cutting away their masts and the Retribution it was feared had lost her rudder.

I am endeavouring to obtain, and if successful, will forward with this dispatch, something like an accurate account of the cargoes of the several ships lost. The Prince contained every thing that was most wanted; warlike stores of every description. Medicines (sic) surgical instruments guernsey frocks, flannel drawers, woolen stockings, and socks, boots, shoes, watch coats, in short all that the foresight of the Government could devise, for the equipment and comfort of the troops, the enumeration of which will be readily furnished by the Ordnance.

The Resolute was our principal ammunition ship, it contained ten Millions rounds of Minie ammunition.\footnote{Minie ammunition is bullets for muzzle-loading rifles, i.e., cylindrical bullets with a conical point. They were invented not much earlier by the French officer Minie (1804–79).}

I hope to be able as I have above said, to furnish Your Grace, with the details but whether I can or not, I earnestly recommend that not a moment should be lost in replacing the ammunition.

The Commissariat losses are very heavy, and lead Mr. Filder to apprehend that we may shortly be deficient in supplies of provisions and forage, but he will of course report fully thereupon to the Treasury, and he will write to the Commissariat Officer in charge at Constantinople, to send up all he can procure in that capital.

I also shall send an officer of the Quarter Master Generals department there to endeavour to purchase warm clothing but I would earnestly recommend that this should not prevent your...
Government from forwarding from England a large supply without delay.

I have the honor to be
My Lord Duke
Your Grace's
Most obedient humble servant
Raglan

(Here follows a brief P.S., which is not material for this paper.)

The listing of British ship losses in Raglan's letter is not complete, not even in respect to Balaklava, to which his letter refers. A more complete account is given by Elphinstone (1859, p. 54) on behalf of the Corps of Royal Engineers. According to him, at Balaklava, 11 ships or vessels were totally lost and seven dismasted; off Katcha, five wrecked and one dismasted; and off Eupatoria, five wrecked. The British losses thus total 21 ships or vessels lost or wrecked and eight dismasted. The loss of the steamers Prince and Resolute off Balaklava was a particularly severe blow, since they carried sorely needed stores (both are mentioned prominently in Lord Raglan's letter).

c. Losses of the French fleet

The losses of the French fleet were less heavy than those of the British. A total of 16 French ships were wrecked in one way or another, most of them merchant ships. However, among the ships wrecked was the battleship Henri IV, which ran aground at about 18 h. All writers refer to Henri IV in such terms as "noble," "pride of the French Navy," etc., and the fact is that her loss caused the strongest reaction and grief. It will be recalled from Section 2 that her loss, and not that of the other ships, prompted Marshal Vaillant, France's Minister of War, to institute an enquiry, which was entrusted to the great astronomer Le Verrier, and that this enquiry had an important positive effect on the leaplike development of synoptic meteorology and, in particular, on the development of the synoptic reporting network.

On the day of the tempest, the Henri IV was anchored off Eupatoria (see Fig. 1). To secure the ship against the storm, it was made fast by no less than four anchors. Suddenly, in a squall of the morning hours, one of the anchor chains broke. It would appear that this occurred about 09.30-10 h. Referring to the mid-morning hours, de Bazancourt (1856a, p. 354) states that there was a "terrific upheaval." This would agree with the log of the British ship Vesuvius, quoted in Section 4b, stating that at 09.50 h "...the wind increased to a perfect hurricane." And it is worthwhile to quote here verbatim a few lines describing the appearance of the sea (de Bazancourt, 1856a, p. 356): "The storm worsened and whipped up mountains of foam on the surface of the sea. Huge waves rose up in terrifying pyramids, opening up..."
suddenly to reveal unbelievable depths into which the ships would disappear for a while, submerged up to their bowsprits as the waves threatened to engulf them.” Not much later, at about 11 h, the portside chain also broke from the violence of the sea.

In the afternoon there was a passing diminution in the intensity of the storm: at about 16 h the wind veered to the west and the barometer stopped falling. But close to the fall of darkness (and this must have been at about 17 h), the wind increased in its fury and the third anchor was lost through the violent pitching of the ship. Shortly thereafter the ship suffered a double jolt and this broke the last anchor chain. The ship’s captain now made an utmost effort to steer the ship clear of the ships that had foundered along the coast. He succeeded in directing the ship to a beach where he could at least save the crew. It was already dark and the storm was fierce. The ship began to go aground when huge waves lifted the ship up on her portside and carried her along the shore until at last she stuck fast in the sand. The next morning Cossacks fired from the coast at the grounded *Henri IV*, but the ship returned the fire. The French painter Louis Lebreton’s (1818–66) conception of the grounded *Henri IV* returning the fire on the morning of 15 November is shown in Fig. 4.

After the Battle of Inkerman, Prince Menshikov said (Seaton, 1977, p. 178) that there was no hope of destroying the enemy unless the winter did it for him.

When Nicholas I learned of the destruction caused to the Allied fleets by the storm, he wrote to Prince Menshikov the following lines (Dubrovin, 1900, p. 293): “Thank you for the storm, it has helped us greatly; another one would yet be desirable.”

**Epilogue**

One of the reviewers of the present paper raised the question of why historians did not give greater prominence to the significance of the meteorological events described in our paper prolonged the war but did not alter its final outcome: The fall of the principal Russian base of Sebastopol (on 11 September 1855) and termination of the war.

**Acknowledgments.** The authors are pleased to record their indebtedness to the following individuals and institutions in connection with this study. In Belgium: Prof. A. Berger, Institute of Astronomy and Geophysics, Catholic University of Louvain, Louvain-la-Neuve, for assistance with literature. In Finland: Prof. O. Jussila, Institute of History, University of Helsinki, Helsinki, for his assistance in checking Russian literature; and Prof. Ernst Palmén, Chancellor, University of Helsinki, Helsinki, for a travel grant to one of us (S. L.). In France: M. H. Cras, Musée de la Marine, Paris, for a photographic copy of Lebreton’s painting “*Henri IV*” (Fig. 4 in the present paper), and for permission to reproduce the copy; Dr. J. Detwiller, Météorologie Nationale, Paris, for his varied assistance with literature and other material and for a useful discussion with him; Dr. J. Favier, Archives de France, and his staff, for their efforts to trace original documents; Dr. P. Pettré and M. H. Darnajoux and J. Page, Météorologie Nationale, Paris, for assistance with literature; and Mlle Alexandre Josette, Librarian, Observatoire de Paris, Paris, for permission to inspect papers left behind by Le Verrier and others related to their meteorological activity. In Great Britain: Dr. B. M. Evans, Archivist, Meteorological Office, Bracknell, Berks., for a list of British ships that served in the Crimean War; Library, Corps of Royal Engineers, Institution of Royal Engineers, Chatham, Kent, and Mrs. Helen Neumann, Nottingham, for their assistance with literature; Dr. P. Warner, London and Mr. Robin Sharp, Department of Photographs, National Army Museum, London, for assistance in connection with G. Greatham’s engraving “Gen. Cathcart’s Death”; and Mr. S. Wilson, London, for tracing the location and obtaining a copy of the engraving. In U.S.A.: Prof. H. Landsberg, Department of Meteorology, University of Maryland, College Park, Md., for permission to reproduce his pressure map for the great storm of 14 November 1854.
in the Black Sea-Crimea region (Fig. 3 in this paper).

Finally, the authors wish to thank Mrs. Ruth Aharonov and Mrs. Fanny Mazur for their kind assistance in typing/proofreading of the paper.

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War Office: W.O. 1/370

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announcements continued from page 1569

Women’s Network in Science and Technology

The Women’s Network in Science and Technology (WNST) is a long-range project funded by the National Science Foundation to explore careers for women in science and technology, and to build a regional network for women in those fields in Minnesota and parts of Wisconsin, Iowa, North Dakota, and South Dakota. The project includes: four one-day workshops to be held throughout the region in 1981, with a greater focus on undergraduate women seeking science careers; individual short-term observation periods with practicing scientists; and a directory of women in science throughout the region to be published at the conclusion of the project. The Minnesota Women’s Center is coordinating and administering the project as a whole. Other groups cooperating in the project include the Minneapolis/St. Paul chapter of the Association of Women in Science, the University and Minnesota section of the Society of Women Engineers, and Sigma Delta Epsilon. Other organizations and individuals are encouraged to join the network. The project is concerned with all areas of science, technology, and social sciences except clinical sciences. The primary goal is to attract women to and retain them in scientific fields.

Each facet of the project will provide data for the directory, to be published at the end of 1981, listing women in science and support systems throughout the region. The entire project will be evaluated extensively by WNST; results will be available in March 1982. For further information, contact: Women’s Network in Science and Technology, 306 Walter Library, University of Minnesota, Minneapolis, Minn. 55455.

Continued on page 1591