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Correspondence between de Saint-Venant and Boussinesq 3: de Saint-Venant's professional career and private life

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Abstract. Adhémar Barré de Saint-Venant has significantly contributed to the engineering sciences. His professional career can be divided into mainly two parts. Namely, until 1852, he made contributions through his engineering works as a practicing engineer and his scientific works at two French academic institutions. He retired at an early age from these institutions, moving with his family to the family castle close to the city of Vendôme, 170 km southwest of Paris. Saint-Venant is particularly known for his research in elasticity, his formulation of the shallow water equations, his hydraulic works, and his interest in the history of technology. He was a person who cared for the professional advance of his colleague Boussinesq, both by posing him relevant problems, thereby elevating Boussinesq's name as an outstanding physicist, and by his wide connections in the French academic world to which the shy and modest Boussinesq was introduced by his master. The Correspondence allows for an alternative insight into the relationship between these two scientists, which also includes their families.

When the Correspondence started in 1868, Saint-Venant had already passed the age of 70. Given this age, he felt himself no longer able to tackle new problems by himself alone. He found in Boussinesq an extraordinary pupil and colleague who mainly supported his master in advancing a large number of scientific questions. The Correspondence thus evidences the sometimes long developments of a final solution to a problem of common interest. In addition, the Correspondence also includes questions on ethics, religion, and the history of sciences. The role of their wives is also highlighted because they had a strong impact on the social relation between the two families.

This work is concluded with hardly seen obituaries of more private than professional nature, by which the many facts not included in the Correspondence are evidenced. In addition, a number of letters written by the eldest son of Saint-Venant to Boussinesq are presented, in which the fate of the many unfinished papers of Saint-Venant is discussed.

Keywords. Biography, Fluid mechanics, History, Institut de France.

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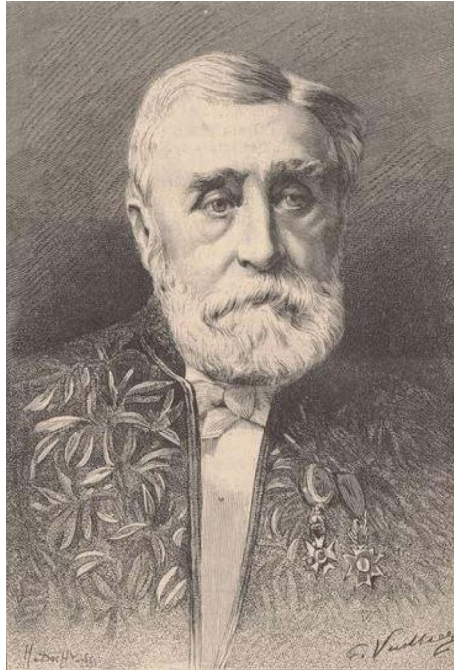


Figure 1. Count Barré de Saint-Venant in the 1880s (*Le Monde illustré*, 30 (March 6), p. 151).

Introduction

Adhémar-Jean-Claude Barré de Saint-Venant (dSV) counts among the outstanding engineers of the 19th century, having greatly added to numerous engineering and agricultural problems. His particularity was the twofold approaches given that he was a distinguished practitioner who was able to recognize the main problems of his profession on the one hand. On the other hand, he was a gifted researcher who presented a number of solutions to problems that had been unsuccessfully tackled for a long time. In 1868, a paper published by Joseph Boussinesq (JB) urged him to contact its author [1]. Right from the beginning, the two understood each other excellently so that a long-lasting scientific and personal friendship developed. The two set up an intense correspondence with each other, the so-called Correspondence. In these letters, both highly interesting scientific problems were discussed and finally brought to a paper and more private issues were exchanged. Their common background was the Catholic religion and the love for their nation, France. This work presents dSV (Figure 1) through the Correspondence as was previously done for JB.

The Correspondence available at the *Bibliothèque de l'Institut de France* of the *Académie des sciences*, Paris, France, offers a unique chance to explore the two masters of engineering and physics of the late 19th century. Hundreds of letters written by the two are archived there. As mentioned by Hager *et al.* [2], the Correspondence has so far never been visualized in its entirety. Given this fact, the first author decided to take photographs of the majority of these letters at various sessions in Paris. Then back in Switzerland, these were transcribed onto an electronic file from where the final translations into the English language were prepared. This prolonged work was considered worthwhile by the authors in the light of the history of applied and theoretical engineering. Therefore, this form of publication was selected. They were published in the journal *Comptes Rendus Mécanique*. In this journal, both dSV and JB published widely their results in typically less than 4 pages.

Note here again [1, 2] that dSV was 45 years older than JB, who could have been his grandson in terms of age. dSV, then a world-renowned scientist and engineer in elasticity theory and hydraulics, was confronted by a young person whose talent was mainly in mathematical physics, who was neither an engineer nor a mathematician and who was self-taught but whose knowledge was encyclopedic, surpassing that of most of his fellow men. In turn, dSV was persistently asking JB for still more advanced insights into a problem, whereas JB largely profited from the many relations of his “master,” as he addressed him in all letters. Accordingly, dSV was largely responsible for the integration of JB at the University of Lille from 1873 to 1886 and then in a professorship of mathematical physics at Sorbonne University, the so-called *Institut de France* or, in short, the *Institut*, then one of the top academic institutions in Europe. Note also that dSV headed the Section of Mechanics of the *Académie* from 1868 up to his death in 1886, whereas JB eventually became the president of the *Académie des sciences* based on the principle of anciennity despite the fact that he did not at all look for such a position given his modesty and his shyness.

Among the many topics presented in the Correspondence, only those relating to the career and life of dSV are considered in this third paper. An imperative restriction on its publication is imposed by the *Académie* [2]. After the first author received access to its library, he had to sign a document in which strict personal use of the letters was requested so that none of the original letters can be published. Thus the only way to diffuse their contents was to transcribe them first into French from where the English version was gained.

The contents of this paper are subdivided into the start of the correspondence and the period of the Franco-Prussian War (1870–1871), followed by JB’s professional career at Lille University (1873–1886). The Correspondence ends abruptly in late 1885 with the passing of dSV. The latter certainly knew of JB’s success in becoming a member of the *Académie* even though the voting process was held 10 days after dSV’s death. Given JB’s age of only 44 years, he was one of the youngest persons in the 19th century who had achieved this particular success. An additional section deals with the letters written by the eldest son of dSV, Raoul, in which mainly the future of the many manuscripts not finalized by his father is discussed. Questions on a bust of dSV are also considered.

Correspondence

As stated by Hager *et al.* [2], the Correspondence between dSV and JB started in 1868. The total number of letters kept at the library of the *Institut* is 600. Except for isolated documents, the entire Correspondence has never been viewed. Given its importance, the authors decided to publish the major findings in paper form. This restriction allows for a first insight into the world of 19th century eminent scientists, who were in personal contact between 1868 and 1885.

Start of the Correspondence

Letter 3, dated April 24, 1868: JB congratulates dSV for having been appointed president of the Mechanics Section of the *Académie des Sciences*, namely: “I have just heard the good news, and I cannot help but assert to the pleasure it has caused for me. By calling you into my heart, where you should have been for a long time, the *Institut* [Sic.: *de France*] made only its duty, indeed a very natural thing. However, gratitude makes us find each other, in the most anticipated happy events that God sends to those whom he cares, the same joy as if they were unforeseen or surprising. I will not stop, dear Sir, being your entirely devoted scholar, JB.” It should be recalled here that dSV took one of the top positions in the French academic system at the very start of the Correspondence. JB, by then 26 years old, without any mentor for his scientific career, must have

realized the unique chance he had by his contact with dSV. Based on a common background founded in the French culture and the Catholic religion, a close relationship between the two developed, lasting for nearly 20 years until the passing of dSV in 1886. Just 9 days later, JB gained entrance into the Institut as a new Member of the Mechanics Section.

During the following one and a half year, the two discuss a number of scientific issues, including the effect of viscosity on fluid flow, the molecular composition of bodies, hydraulic friction, the question of zero velocity along a fixed wall, the definition of force, elasticity, the principles of mechanics, heat, gas diffusion, rotational movement, orifice flow, fluid flow without friction, experiments of Savart on fluid jets, periodic waves in fluids, and philosophy and mathematics. This short list of subjects reveals the numerous topics argued by the two colleagues. As stated by Hager *et al.* [1], JB considered during his career all topics of physics except electrodynamics.

It should also be mentioned here that these subjects of research were often proposed by dSV in having questions on a particular phenomenon. Normally, JB attempted to offer his views on it, finally reaching a novel conception, culminating in a paper. A typical problem considered successfully by JB was addressed in early 1870 when dSV had to deal with the pressure distribution of pillars placed on sand. JB was finally able to present a paper that revolutionized the solution to this important question. The paper was finally published in 1876.

Franco-Prussian War

The steady progress in the construction of solutions to problems in physics was abruptly interrupted by the start of the Franco-Prussian War. In [Letter 19](#), dated September 1, 1870, dSV adds at the end: “My daughters and their mother will go, as the enemy approaches, if he comes to Vendome which is a little safer [Sic.: than is St. Ouen]. My two sons and their soldiers, who are more or less armed and disciplined, will be sent 3 hours away from here, to a wooded commune, crossed by the great road to Paris.” The answer from JB to dSV is formulated in [Letter 20](#), dated September 4, 1870, reading: “Receiving nothing from you, we fear that so many unfortunate one-off news have affected your health, or perhaps the Prussian approach has disrupted the Loire-et-Cher’s postal service. We follow with concern every day the movements of the Prussians on your side, and we pray to God to keep them away from Vendome. We are persistently thinking of your two sons, and we would like to have them again in Blois. Why, if you are in danger, would you not come, with Madame Countess and your daughters, to spend autumn and winter in the Alps, where life is easy and cheap, and the air is very healthy, where the cold, despite the altitude, begins only at the end of December? Gap is a country so far away from any railway, despite beautiful roads, and, moreover, so poor that one can hardly expect Germanic rapacity. It takes, by fast couriers, 18 hours to get there from Marseille, and 15 to 16 from Orange or Gap. The most direct route for travelers arriving from Toulouse or Lyon is that from Orange. We usually leave at three o’clock in the afternoon and reach Gap at five o’clock in the morning. The trip takes 15 km: this is the only part of your journey that can be a bit boring; however the car is very comfortable. It is with great happiness that we will receive all three of you, by putting all three of us at your service. I have the honor of being, with deep respect, Mr. Count and dear Master, your devoted disciple, JB.” The invitation of Boussinesq to dSV and his family was a gesture of friendship and deep affection. The answer of dSV is given in [Letter 23](#), dated October 9, 1870, and it reads: “Thank you very much for thinking of us by your kind offers of asylum that would be nice for me. However, I prefer to stay here, and my family would simply go to Vendome, an open city that can only be afflicted by requisition. However, we have, in addition to our own mobile guards, those of the Department of Gers, whose posts spread in the woods along the main road. You’d better be, with the soldiers, in towns or villages, than in this town of Blois where they should be undisciplined and capture a bad temper.”

Toward the end of October 1870, the war reached its peak. dSV states in Letter 25, dated October 28, 1870: “The surroundings of Vendome were these days a camp of fifty thousand or even a hundred thousand men. As the hill that dominates the pointed roof of my house was bristled with cannons, we were exposed to their attacks and counterattacks; we thus decided in case our troops had some needs for the lower floors, to move upstairs all our furniture, my voluminous library and my many papers as well as ourselves.” Letter 26, dated December 10, 1870, includes a description of war activities by dSV: “I think that you and Mrs. Boussinesq are thinking often of me and my sons. So I don’t want to wait any longer to tell you about my dearest as I continue, to give you our news. Vendome heard the guns and the shootings close enough, but was neither besieged nor taken. We have many reasons for hope that if the enemies return, St. Ouen will separate my home, at the top of which the neutral flag of ambulances will flutter, because I have eight or ten beds taken by sick soldiers. My two sons were wounded in the unfortunate battle of December 2 near Orleans. The day before, the weather had been brilliant for their mobilization of [Sic.: the Department of] *Loire-et-Cher*. Yet that day, my eldest son fell, hit by a bullet in the leg or thigh. His brother is not worried about his life as he was seen leaving the hand-barrow and walking 900 m supported by the shoulders of two soldiers. However, since then we have not heard from him and all assume that he is not a prisoner.” dSV continues: “His brother, the forester, was shot in the foot, which produced only a contusion, without real injury, a shrapnel that removed a large strap. He was able to pick up his fallen sword with his left arm, and beckon his soldiers to continue the fight, which soon had to be a retreat, given the superiority of the enemy forces who would envelop what was left of the battalion. After a good bandage, he was able to write to us with the same arm that had been hit, and could be transported to Blois from where he returned the day before yesterday to our midst. His wound was on the way of recovery. Yet, France is very sick. When will God find that she has suffered enough of necessary humiliation and that she has enough atoned for an entire century of dying, blasphemy and spreading of bad doctrines, and that she has by now become worthy of being and showing herself what she is in her soul, currently the most Catholic nation in Europe, and the imperishable sword of the Church of its leader!” In contrast to previous years, the year 1870 was not good, mainly for dSV and his family. The war activities continued also the following year as is described below.

Letter 2, dated February 9, 1871, was written by dSV, stating: “My two sons, wounded in the fight of December 2 at Loigny out of Orleans, are doing as well as possible. The second, Julien (the forester) [Sic.: 1847–1930, archaeologist and historian], to whom this brilliance of obedience had taken away a large piece of the arm, is very much healed, and is not a prisoner, because he was able to escape and return to my house before the invasion of Vendome. The elder, Raoul [Sic.: 1845–1927, historian], aged 25, is in an excellent healing path from the bullet received at the top of Semur. I was for a long time without news of him, finally I learned by chance that he was in an ambulance of a small town not far from the place of combat, twenty hours from here, from where he had written us up to six letters which did not arrive until Christmas. I was there with my elder daughter, passing through a country whose hostels were full of Prussians. We found him already well except for being wounded but in good condition, well cared, because one of his soldiers and nuns had offered mobiles; his friends, wounded like him and declared prisoners, whom he only missed because they were kept for recovery in Germany. My second son went to look for him but could not yet obtain the permission to bring him back here, since the Prussian authority will no doubt find that he could escape to take part in the war if it began again.”

“We applauded for staying at home, because the homes of all those who left them were devastated. Yet, we had days of strong emotions, with some losses, and our Red Cross flag was not always respected. So, as a taste, a captain came to ask us, in harsh coldness, to empty our ground floor that he needed, sending at the very moment, our seventeen sick patients to Vendome, which

had to be done immediately. However, only our commons and a room were occupied, because higher up, only a few bullets on our side arrived. They brought us 40 wounded Frenchmen and 2 Prussians. My daughters, my son-in-law who had been on the battlefield helping to pick them up before the fire had stopped, treated them. Some succumbed, but many healed and left, and we have only about 15 left, of which, with the exception of two, we hope that all will heal. We had the burden of burying one more yesterday; a captain, whom we had cared for, succumbed. Besides, everyone is religious. They're soldiers of whom many wear medals or scapulars."

"Our parish priest, whose presbytery does not guarantee safety, as to us on the hillside, had been riddled with shells, came to live in *Villeporcher*. He recently said that his mass held in our dining room was transmitted by two open doors to the vestibule and from there to two salons, where the wounded people were attending. However, at the first day of the year, in the morning, two Prussian soldiers arrived in the vestibule taking the rifles of the wounded, and broke them on the steps of the porch. I do not recall another mass so interrupted."

"A few days earlier, an emotion not less severe of a different kind occurred: two Prussian soldiers refused to deliver to my daughter Mrs. de Bodard [Sic.: Marie de Bodard de la Jacopièrre, 1843–1944], 29 years old, our oats, necessary for our horses which are serving the ambulance; one of them, probably drunk, drew his sword. Mrs. de Bodard's maid stepped in between and was hit on the forehead. Although the injury was not great, she felt it for two weeks. And the Hanoverian captain came to offer excuses promising punishment and to return the bag of oats. Yet, there have been other wood, oat, hay removals, burnt barriers, etc. Not to mention a small building burned by carelessness in the middle of the night. Another night, at one o'clock in the morning, I hear the dabbling of soldiers suddenly filling the house. They accompanied a wounded general and his staff, who asked for the rooms and the beds of my son, my daughter and my son-in-law, yet they left the next day. In total, we are not among those who suffered most. However, without the return of revenues, we live on credit and do not know when we will pay or how to cover our revenue losses in Paris and elsewhere. We will start to count, as friends or relatives, and will at least find, dead of injury or smallpox that was a real infection. We have suffered some losses, among the best. Receive the new and sensitive expression of my very affectionate feelings while waiting, dSV."

This letter evidences dSV as a person who loved his family. He was hit by the war actions but was finally happy that none of his dearest was killed. JB was most probably the only person who was told the details of all these incidents. This was therefore a new band of relationship between the two scientists at a private level. As noted by Hager *et al.* [2], the year 1871 was that in which both scientists were able to present outstanding results, dSV related to the shallow water equations and JB to the fundamental open channel flow features.

JB at the University of Lille

At the end of the Franco-Prussian War, the French King Napoleon III stepped down from his throne. This initiated the start of the French Republic. France had lost a lot during these days, mainly the honor of its country, the trust in its leaders, the reputation among the European countries, and the value of its currency. The future did not look attractive; the majority of Frenchmen were worried and felt insecure. Furthermore, JB went through a difficult phase because his professional future was unclear until the end of the year 1872 when he was appointed professor of mathematics at the University of Lille [1]. This success would hardly have been possible without the strong support of dSV, who knew how to advance things best under these difficult conditions. As a consequence, JB was now professor at a top university, and his ways to both Paris and to dSV had become much shorter. Accordingly, from 1873, JB looked confidentially into his professional future.

During the years 1873 and 1874, dSV proposed to JB the study of a variety of subjects, e.g. the resistance of walls against earth pressure or the movement of molecules kept in confinement. dSV simply felt that the knowledge, then available, was much below that necessary to design and execute for example large railway projects or the construction of large buildings. JB, who had never before studied these problems, was able, with the support of the engineer dSV, to tackle these problems and finally published papers that added considerably to the theories of e.g. Rankine. The combined attempts of the two scientists thus succeeded in most cases. dSV was satisfied with the solutions presented by JB, whereas JB was happy to have been able to support engineers by his excellent manner in setting up computational models and finally solving complicated equations. Thus, both profited largely from each other. A typical note addressed by dSV to JB contains Letter 14, dated July 31, 1874, in which dSV writes: “Dear Sir, when I send you writings or prints, often voluminous, it is as much to have your opinion on what it contains of ideas as in the thought that it will be able to stick to something that interests you. The mail sent by railway track does not require postage as the use of the post office. So don't bother, another time, to ship me money. Thank you for considering it like a rest when you write to me. I hope you always do that, dSV.”

“I was the one who said that the Newtonian attraction could probably be explained as that of two small, dry floating bodies. The expression is not exact as you point out to me since, in space, these are no actions that depend on the curvature of a fluid surface, but the idea itself is independent of that expression or comparison, and it is not due to me. It can be attributed to a certain extent to Mr. Azaïs [Sic.: Pierre Hyacinthe Azaïs, 1766–1845, French philosopher] (a man of imagination whose universal equation hardly seems to me worth the trouble to be the object of your study but that I will send you, if you wish) and therefore of universal repulsion, and it is found a little more detailed in an 1841 pamphlet by Mr. de Tessan [Sic.: Urbain de Tessan, 1804–1879, French engineer in hydrography]. I understand, from this idea, that, if two bodies AB, A'B' float in a fluid, such as ether, whose molecules are repelled by theirs, will be less dense in their interval BB' than from behind AA'. So, each of these two bodies, AB for example, will be pushed less to the side of the other body, namely on the B side, than it is on the opposite side A. Hence, the apparent attraction of these two bodies, at distances where their own mutual repulsion is too weak to counterbalance this uneven repulsion of ether on both sides.”

“I admit that this reduction of the two laws of attraction and repulsion to one, namely the repulsion, or what Azaïs calls ‘universal expansion’, pleases me, despite the difficulties it can persecute, and even though the impression is suggested that the cohesion of the diamond is just an external pressure of the ether. Azaïs did not leave a certain genius, in particular his originality and some concrete ideas, such as his universal compensation system, which was the subject of many jokes some sixty years ago. Damiron, whose history of philosophy systems in the 19th century is probably kept in the library of the Faculty of Lille and that of Amiens, dedicated one of his chapters to him. I wish you and Mrs. Boussinesq a very good trip, and a rest that makes you feel better. Your beloved dSV.” dSV loved to expand on topics as reproduced in the above letter. He had nobody at Vendome who would listen to these philosophical ideas, and JB appeared to him as a person who could even add to his thinking and hypotheses.

dSV was also the person who proposed to JB how to socialize with colleagues. As described by Hager *et al.* [1], JB was a shy person who had no intention of becoming too close to others. In Letter 28, dated July 27, 1875, dSV states: “You will go to Paris in three weeks. Could you stop there to see some persons, to make some acquaintances, some friends in Paris, because I cannot be really useful to you, I no longer have time to make steps. You may have more disposition than me to make those people friends to you with whom we have common pleasures, even honest and permissible pleasures. You are self-sufficient with science and Madame Boussinesq, and corresponding with me. Well, did you know how to feel the heart of a lot of men (otherwise

unsympathetic of course), and get to see them, to entertain them, and to be pleasant to them? One may imagine that someday, perhaps, we can contribute to their salvation, when it would only be by the good example, or by the prayers that one will make to God for them. Let's hope and do. Your beloved dSV."

In [Letter 31](#), dated August 1, 1875, dSV gives advice to JB for his professional future. He writes: "Dear Sir, your petition to the Minister is excellent. Certainly, if we had something like the king who made of France his own thing, all personal as a family, and who heard and claimed that all worked well and properly for the greater glory of France and of God, saying and understanding for its best and legitimate future without using the phrase that I find beautiful: 'The state is me', it is my heart, and all you do for it I look as done for me or for God. The good and excellent reasons you provide would be taken into consideration. One could, in order to please the master, the temporal representative of God, to contribute to the glory of his reign, to create a new chair if necessary, to find the 6000 francs it takes for this, or to bend the rules all by respecting them and to have them violated. However, what do you want the Ministers of a poor President to do, who depends on the Deputies, on the voters, who depend on journalists, or bar leaders? They generally do nothing but cover their responsibility, say, 'These appointments are none of my business, I can only approve the proposals of the teachers' bodies, even when I know they are the result of intrigue or influence'. Also, while continuing to acquire titles and exhibiting them every 6 months as your Rector advises you, I can only commit you to always try to make friends in Paris. There are many topics of conversation that can be started and that are by no means idle or easy. For example, could you not, knowing just what it takes (I suppose), consider questions in astronomy, higher algebra, superior geometry too, or vectors, electricity, acoustics, theory of numbers, quadratic forms, quaternion, invariant or covariant, or chemistry. Knowing, I say, kinematics, either general or industrial probability calculus of all this, all of which is just what it takes to talk about, could you not visit those who are special, ask what such and such points are, what their uses are, who introduced them to modern science, etc. Be assured that those to whom you will pose such questions will be flattered, will be delighted to answer. Those far from finding you ignorant, each of them will admire your intelligence and the extent of your ideas and even your knowledge that they will in turn ask you about what is special to you, and will find that one can do better than to call you to expose it." The last sentences mirror an essential element of dSV's way of thinking, his way of making acquaintances, and finally also his social successes with his surroundings. He has clearly realized that science alone will not bring luck on earth; in parallel, he understood that socializing along will also be the aim to pursue a whole life. The mixture of the two, however, may bring you to the point where a human life is sufficiently worth living along with the necessary spices to become an accomplished person. He thus communicated the secrets of his long life to his best colleague and friend.

The letter continues: "I haven't seen any sign of your left-handedness yet. Besides, I would not want to force nature, to irritate, to make you an important visitor and idle talker. There's one measure to keep. However, relationships are, I think, necessary for you to build up so that you can make yourself known and accepted, in the interest of science, through the results of your work. Nor is it that I want to commit you to learn all those parts of science that I listed, if you do not already know them. You've got other things to do. God only likes it if you become an amateur. Your dSV." JB was certainly grateful for dSV's comments both for his professional career and for his personality. He greatly profited in this regard also from his wife, who supported him in all respects, so that finally all those who were involved were able to have an excellent understanding of each other. It is true that dSV also asked for many services from JB, in his own interest, because he felt unable to develop several theories whose foundations were laid by him decades ago. JB appeared to him as a person capable of doing it. Both were thus highly motivated to advance science and to solidify their personal relationships.

In Letter 4, dated March 10, 1876, dSV proposes to JB a means to improve the then current lecturing, stating: “I myself, in these long letters, told him [Sic.: to Professor Paul Serret, 1827–1898, French mathematician] how I understood many points of this teaching, though I never professed it, and that I never kissed any parts of it at all. I would urge him to use exclusively the ‘method of infinitely small’, without evading it at every moment like Duhamel and others by conforming to it in appearance and for any form to obtain the decree. I told him that from the age of thirteen, the infinitely small and infinite considerations seemed to me, in geometry, all that is in the world, clearer and more acceptable, despite the mystery of the principle, that the exhaustion of the limits are fading. Serret merely masked the ever-inevitable infinitely small because it lies at the bottom of continuity. I added that by means of this simplification, the saving of time and the fatigues of mind, his teaching could rise to the differential equations to which any problem leads without real things. I also said that the mystery must be accepted even in mathematics, as a religion, where it did not accept perfect clarity of practical consequences; moreover, the use of infinity did not in any way interfere with the need to admit infinity into the things created and irrelevant, that is, infinity in space is envisaged as a reality, not divinibility [Sic.: this is the property that each body can be separated into distinct parts] from the matter to infinity, that is, two absurd contradictive things, as is the infinite number, that space and time are not realities but only possibilities to contain, one of the maternal beings, the other of events. Possibilities that nothing prevents us from looking at it as indefinite or limitless since there is no one with the power of God, who is the one and only infinite one. On this subject, I was recommending him a rather good brochure of Trauson, presented at the Academy by Elie de Beaumont on August 7, 1871, with an Extract at p. 367 of the Report, where he refutes, as he mentions, the non-Euclidean who regret the demonstration of Amiot [Sic.: Antoine Amiot, French 19th century mathematician] of the sum of the 3 angles of a triangle, and where he says that geometric indefiniteness has its reason only in the infinity of God, so that the inevitable considerations of infinity, or geometry under one of the strong evidence of his existence.”

“Are you entirely of these opinions or not, and do you have reasons (other than the need to conform more or less with the opinion and judgements of your students) to present things differently in your course? Above all, I want to tell you that you are like P. Serret and unlike many others. Let him deeply regret that your intention is not to put yourself into the teaching habits of Catholic universities. I told him that you would be very worthy in all respects to have your place, and moreover, that he supported so much your ambition to arrive at the College of France. My opinion is that your place is there, that he believed that this was also the general opinion, which, at this point, agrees by chance with the truth. So take good courage. When you pose a question, do it boldly, like a man who asks with the intention to devote himself to science and its expansion without his true point of view which is that of real things, and to accept the decadence that perhaps threatens as it threatens everything in our poor France who will let herself pass through the body of other nations if she is not careful, while it is in her (and by their admission) to dominate them.”

“And, while waiting for such a result, continue with your work that makes you even more aware, by sharing your communications, by which you find a way to make them clear. I would prefer rather this bold tendency at the *Collège de France* than this chair at Sorbonne which was created in spirit and with an industrial purpose, and which will require the kinematics of mechanisms, a chair which, moreover, at the moment, seemed unaffordable to me as I said yesterday. Your beloved dSV.”

Thus dSV has definite ideas on the future career of JB. He sees him as a successful researcher at one of France’s top institutions. Note here that dSV stopped his academic career at the age of 55 because he preferred the future as a private scientist. He, of course, had in addition the necessary financial background allowing him this lifestyle rather than being squeezed in the daily affairs of a university, in his case the Agronomic Institute at Versailles, which he left after only 2 years.

Over the next years, nothing exceptional can be reported about dSV. It was around 1877 when his writings became worse and worse so that some letters can hardly be read. Even JB made notes on the margin because he was equally unable to decipher the words written by dSV. In 1877, the topics considered included ethics, moral philosophy, thoughts on God, concerns in religion, determinism, or the “*principe directeur*” [Sic.: in English, guiding principle]. This was also the period when dSV became ill. JB writes in Letter 74, dated May 26, 1877, to dSV: “I learned with great joy that you are starting your walks again. This inconvenience was probably not a cause for concern, but it is even better that it disappears. Madame Boussinesq is also very happy with your recovery. She joins me in congratulating Madame de Saint-Venant, to whom I beg you to pay my respectful tributes. The presence of your brother-in-law must be very pleasant to you all. Please, if he is still in Villeporcher, offer him my respectful compliments. Perhaps he has some relations with Mr. Brunet, Minister of Instruction. I think it would take very little, after what was said to me in the Department, to be appointed, in Paris, as a Lecturer. When the current minister returns in October, he may not be here. Although there are only six or seven weeks left until the big exams start in July–August, I would have several interesting subjects that could completely be dealt with during that time, and which would initiate young people very well to the true method of the mathematical study of natural phenomena.”

The letters contain less material on the more private side of the life of dSV. Letter 90, dated August 7, 1877, is an exception, reading: “Dear Sir, my daughter is relieved, we are out of worry, she still has for a month, maybe two, of discomforts, but we see an end.”

“Do we owe it to our *novena* [Sic.: a prayer then made in France], or to the prayers of our friends, including yours, for whom we thank you as well as your good wishes? God knows, but what I was certain of it that every time I said the litany of *Notre Dame de la Salette* [Sic.: This is an unmissable site of *Matheysine* [Sic.: a natural region of southern Isère River with plateau-like relief and surrounded by mountains] and an important pilgrimage in France] I won, if I said them [Sic.: these prayers] with attention and confidence. 40 days of indulgence, since the Bishop of Grenoble thus decided it in the fullness of his power. In a few days, we will have news of this blessed mountain, because my son has just made a pilgrimage, as did two years ago a daughter of St. Ocrez and also my niece (daughter of the magistrate of the Court of Appeal of Paris) with her husband, general of the Division of the Aydren Abbad, who, when he commanded the School of St. Cyr, did not bother to celebrate his Easter in front of the students, among whom there were not as many merchants as lieutenants. My last two daughters will make a similar trip next month with their brother, the forester, but it will be in Lourdes which is not so far away, and for which there will be a cheap train. Perhaps they will have the chance to see a cure like the one my first son-in-law witnessed two years ago.”

Letter 25, dated November 3, 1878, contains an important statement of JB, namely: “Don’t worry about priority issues between us: it’s so little! I renew, in this regard, my promise to do my best, if I survive you, your obituary. This will be my good task towards all future workers, who will see that we can, through love and habit of work, keep the most vivid intellectual activity, the most complete flexibility of the mind, until an age quite advanced, that one neither can get tired of scrutinizing, learning and thus spending one’s life happily here on earth, not to mention the merits that one may acquire from the others by remaining faithful to one’s vocation without ever getting tired. Avoiding the crystallization of the brain, while others are already at forty, almost unable to think of acquiring a new idea, is wonderful! And there is perhaps no better proof of the distinction of the soul and body, of the ‘*mens agitat molem*’ [Sic: The spirit moves the matter (Vergil, Aeneis, 6.727)]. It will be for me, if I survive you, a duty of filial piety, let me say this word. I see no other that describes my thoughts, although it may be rooted in the limits of humility that I should not part with you in my relationships with you. Yet, if, on the other hand, I would pass first, which is not likely in all probability, I would ask you to devote some of your precious days to a

simple analysis of my memories (for my life would not be worth telling).” Indeed, JB prepared the obituary of dSV together with his colleague Alfred Flamant (1839–1915), who also collaborated with dSV mainly on questions of elasticity [3]. The obituary contains also a bibliography of dSV’s main writings.

Letter 1, dated January 9, 1879, of dSV to JB, includes statements on the current health of dSV, by now of age 82 years. It reads: “Thank you for your good wishes and that you always think of my health. I’ve had a cold and I’m still a bit like I’ve had every winter since childhood, without getting any worse. I make use of a cup of tea each time and without the slightest scruple of sensuality, a bottle of hot water in my bed, which is more convenient to me than to go around the park two or three times with or without umbrella, before going to bed, to do it to have warm feet, as I practiced a few years ago.”

“Unfortunately, the day before yesterday, we had great sadness. The second son of Madam de la Serre, less than six months old, passed away in less than two days by pleuropneumonia. We were so far from fearing it that six members of the larger family, in the morning, exempted from going to dinner at our neighbors at the top of the hill. Obviously, before the event we had canceled it. You feel the desolation of his mother, grandmother and father despite their courage. I was seeing the dear child in his cradle: this beautiful innocence! And by shares I had great worries about my first son-in-law, who very much also reached the same illness, but he is quite convalescent, and was able to join us for the general family reunion of New Year’s Day, which still lasts.”

“And you, who are transported perhaps for your whole life (because Paris looks like Lille) in a climate that is not yours; you will also have precautions to take, without making it a concern worried and able to increase the evil, because you have a very good sister of charity, whose care and affection you can appreciate.” At the end of this letter, dSV returns to the previous letter with the words: “Thank you for your offer to prepare my obituary once I have died. But above all are my unpublished works that I recommend to read so that what can be found there, if there is something, is not lost.” JB also fulfilled this important request of his colleague as will be noted at the end of this paper. A number of writings of dSV thus were finished without any mention of the true author.

In Letter 5, dated March 1, 1879, dSV starts preparing his short biography. It reads: “I send you this hastily written lithograph for the students so that you have just about everything I have done. I would ask you, for the time when I will have left this world, less my biography than the publications (on behalf of my family in the absence of a publisher or insertion in collections) of my work whose writing has not been completed or the publication not yet made. Yet there is perhaps nothing in this notebook but the seed of my later work (in the *Comptes Rendus* 1843 and 1844), and there are many errors, for I looked at the Sections which remain hovering. However, it was from this work and my memoirs of 1843 (August 30 and September 6) that Poncelet gave me the idea to present myself at the Academy and made me, with Cauchy, wear the first tie with Morin [Sic.: Jules Morin, 1795–1880, French general and engineer]. He had especially noticed my approach (No. 26, page 26) to take into account slippages in calculating the resistance conditions, and the inflexion of rings, see No. 82.”

In Letter 3, dated February 11, 1883, dSV recalls the vote in 1868 when he was elected president of the Section of Mechanics, stating: “Dear Sir, if you succeed [Sic.: to be elected member of the *Institut*] you will have been correct, but it is unlikely. Accusing an entire Faculty of having a mixture of fear and cramping, makes a big inequality, to say that it has no judge in its heart in mathematical physics; it is very strong even assuming that this is true and it is hardly forgiving.”

“Besides, sometimes the headaches succeed. Without what was called my affair, which consisted, in 1866, of leaving the Section by removing me from the list of presentations where they wanted to put me after Phillips (deemed more capable of being opposed by Mr. Favé). Without

that, I said, I probably would not have had my 38 votes in 1868, where the Section first wanted to oust me because of bad character. But it doesn't always work this way."

"The permanent Section doesn't appear strong in mathematics. Writing to Mr. Du Mesnil (Commissioner of State appointed for political reasons) would be, I think, useless. However, he has heard of you quite often from me to know you, and you can write to him. However, I will write, when you wish, to Mr. Gavarret, whom I have seen several times in my presentation of 1866 and who, with regard to Mr. Favé, unashamedly deposed against the spirit of servitude, the need for prostration, which makes the current love of money and enjoyments. Moral state that has not dominated since there is no emperor or aid of camp (Favé, emperor). Besides, you know that at that time in 1866, Phillips was not named, but Foucault, who arrived as third thief of a donkey [Sic.: from a French proverb, when two fight for something, a third may be lucky by just taking it], although the Section did not have him on the list. Yours dSV."

Letter 14, dated October 27, 1884, written by dSV to JB states: "I still have excellent health, which even worries me, for I fear to atone by a longer purgatory, for my sins, my exemption from personal suffering in this world. However, I am very distressed by the suffering of the beloved mother of my children. It was established, along with [Sic.: my daughter] Genevieve, at the home of my elder daughter Madame de Bodard, while we change her room here. Nevertheless, she remains there, surrounded by several treatments, because the sufferings of her neurosis, sometimes called false angina, will only very slowly fade, and it must always be instilled by stings, morphine. I go to see her every Sunday and I can only talk to her very little. It is said that this does not reach the remaining organization, but it's painful. I have just been told, however, that she is getting better."

"As to you now, do you feel any less pain in the personality of Madame Boussinesq? I pray to God that he will give you this help, this support in your constraints, this zealous collaboration of your useful life. You're the one who's serving her now. Spare nothing to let her take the 17 °C she needs to expel her bronchitis, fortunately, as for me."

"My work to be completed and which I am taking care of, is unfortunately driven by the need which I fear to have to go through all by less, in order to understand it. It consists of the collections on electricity, which I am sending free of charge, the splendid collection to the weekly continuation, for this makes us a little familiar with it, though those who are dealt with by the scholars as if they did not understand it. Indeed, we always wanted to incorporate this in the Mechanical Section, and we must put in order the reasons that support the Section of Physics. In the long time, this will even affect the Institute, of which the science is still so confused by mathematics, since Clausius [Sic.: Rudolf Clausius, 1822–1888, German physicist who proposed the second law in thermodynamics] speaks in a different way than Deprez [Sic.: Marcel Deprez, 1843–1918, French physicist and electrical engineer]. It is better to leave it for a long time to the makers who claim for the funding and the issuing shares in this subject, without misleading our academic honor."

In Letter 5, dated February 24, 1885, dSV proposes new research topics to JB, stating: "To give you new research topics, the idea of which has often been provoked by your reading or indication, I send you the 'Kirchhoff' [Sic.: Gustav Robert Kirchhoff, 1824–1887, German physicist] that I have told you about. I do no longer have time to annotate everywhere by chapters or *Vorlesungen* 18th, 19th, 25th, 26th, so that you can fully understand what it is without doing it; the movement of a sphere or an ellipsoid in a fluid, without or with the consideration of friction (regular friction or in the manner probably due to Navier) to make you understand what this problem is, namely the movement of a solid in a fluid, which has also been treated by others, e.g. an Englishman, whose large volume I have sent to you a long time ago (isn't that Stokes?). This would be a subject worthy of being treated and managed by you because its rational solution would be that of the true determination of the impulse of the fluid on the solids. This must reduce to zero when the

relative movement has arrived at a steady state, when we neglect any friction of the fluid on it and on the body. The calculation is more complicated when one takes into account a regular friction given by Navier, when considering slow movements (as you have considered in the complements to your *Eaux courantes*). This is the real and only solution to the problem of the resistance of fluids to the movement of a solid in water. This problem treated by d'Alembert, Euler, Borda, Bossut who abandoned to leave the solution to their successors, and Navier who, having not known this, has in vain tried to give something by evaluating, like Robins, the centrifugal momentum on the advance of the plunging body. When friction is neglected, one has a suction or a negative centrifugal pulse that precisely compensates and neutralizes the positive pulse from the front, as we can see from the four authors cited, paradoxically, as d'Alembert says, or, as I said (*Comptes rendus* of 15 February 1847, p. 243), this paradox can only be resolved by taking into account fluid friction, the only real cause of the resistance. Well, if you understand what the English or German authors, who dealt so often with the problem of the movement of a sphere or an ellipsoid in a fluid mean, you will see, when one assumes permanent movement, that:

(1) they found a result for the actions of the liquid on the solid by excluding friction, because their analysis must have been defective;

(2) what result they found by taking into account Navier's friction law (the only possible, I want to account for in such an analysis), then they would have solved analytically, for the first time, the problem of fluid resistance, or its effect on an immersed body, assuming very slow movement so that they will operate regularly or without vortices;

(3) if they did not consider the movement that reached the state of permanence, if they had, for example, assumed that the solid or ellipsoidal body fell vertically into the liquid, you will see whether the solution of these learned men is good, sound and actually physical, or whether it is only an exercise of analysis carried out through hypotheses and deletions, and you will see, after having properly compared their analyses, that there is no way for the solution. You'll also see whether it wouldn't be appropriate to assume zero velocity around the submerged body, as you did for the bottom velocities when you analytically explained the results of Poiseuille's experiments. However, this would be a real development of Mr. Kirchhoff's calculations, supposed always applied to slow and steady movement; the results you would present would be better than theirs."

"As for the faster movements or those with inevitable vortices, I am afraid they should not be treated unless the evidence is extremely elongated or fishtailed. In any other case, it is preferable to settle for the calculations of approximations and it is by no means sure of what Poncelet gives in his final addition to 'The Introduction to Industrial Mechanics' of 1839, by perfecting the calculation of what happens at the front of the submerged body. I did this in an unpublished memoir that you had in your hands and that I will send you again if you wish, and as did also Bélanger."

"I believe that the study of other parts of Kirchhoff's book may give you information to open your mind to new researches on physical mechanics to which your potential might apply. For Kirchhoff is a serving author of Weyrauch [Sic.: Jakob Johann von Weyrauch, 1845–1917, German mathematician and engineer], of whom I will send you two works on earth pressure, where there may be good things, but which must be much less advanced, in fact approximations of the correct solution, as applied in your latest work. Yours dSV."

The proposals made here by dSV, in the meantime close to 90 years old, are indeed notable. Of course, he had in mind his own advance of this eminent problem, which he never reconsidered for nearly half a century. If not he himself, then JB could be the person having the necessary knowledge and the sense of feasible approximations to finally bring it closer to the correct solution. dSV obviously realized that the main forces should be investigated for laminar flows because the "inevitable development of vortices" otherwise, as he correctly stated, would even

more complicate the solution. dSV, a man of action, would have been happy to see at least a rough concept of the solution, yet JB could not act so quickly.

In Letter 6, dated March 1, 1885, JB writes to dSV: “P.S. I cannot comment on the generalization of the reciprocity law demonstrated in No. 30 and 31 of my ‘Application of potentials’, since this generalization, in its most important part, was noticed first by Mr. Cerruti [Sic.: Valentino Cerruti 1850–1909, Italian physicist, contributing to the Boussinesq–Cerruti problem in elasticity], and not by me. Each to his own good.”

“And then I’m killed by work and I am going to be crazy. I need 2 years of absolute tranquility for the writing of my course, writing more than thirty responses to various Correspondents which during the month of February prevented me from moving forward. I am in despair, and if you have any pity for me, avoid asking me any questions for some time.”

In Letter 13, dated April 7, 1885, dSV has a sad news for his colleague, stating: “Have I already written it to you, dear Sir, and old friend? I don’t think so. The day before yesterday, April 5 (Easter), at 4 o’clock in the evening, the mother of my children, the one who appreciated your good visits so well, left us and left this world, at her old daughter’s house, an hour and a half from here, where we thought her long pains would be better cared for by two of her daughters and far from the noise of the granddaughters here. It is the end of a long and intense suffering of a neurosis which made, despite the remedies advised by a high medical authority of Paris, by agreeing that she had suffered from the spinal cord. It is the end of a life of devotion to one’s own, and also to the good, and thoughtful administration of the family’s fortune. On the Holy Thursday, she had received the extreme unction at half-consciousness. Tomorrow we will bury her in St. Ouen. We had been married since October 30th [Sic.: 1837]. I am certain of your prayers. Yours dSV.”

Notably, this topic has no longer received any word in the Correspondence. It should also be noted that a number of letters from JB are most probably not available given that his first written reaction is present only in a letter dated June 29, 1885. In Letter 22, dated July 5, 1885, dSV writes: “Dear Sir, I expect you will ask for a dinner tomorrow, Monday evening. Please do this as simply as possible because I have reasons to diet. My son Raoul will pick me up at your house at about 10:30 to take me to the railroad. If I have an opportunity for Vendome today, I may send you in advance what I am referring to the *Serret* committee as a preface to the presentation... It will be possible that during the day I will drop off these two writings at your home. If I’m not warned up to 7 o’clock, start the dinner, I’ll only ask you for a piece of cold meat and cheese. Yours dSV.”

In Letter 25, dated August 8, 1885, dSV states to JB his last wishes, namely: “Dear Sir, thank you for asking me with so much affection about my health. It is still perfectly good, even though, tomorrow, Sunday 23, I enter my 89th year.”

“If I don’t give you my news as you kindly gave me yours, it’s because a few letters are enough to make me spend my entire morning, even starting at 4 o’clock, and I now have many more occupations than ever before. First, I have to distribute my goods to my children by reserving only my usufruct plus what it will take to continue the works of their mother, to add others when the Church is separated from the French State that will steal it and make it bankrupt. And also, to continue the honorability of my house which must remain the center of the family and friends of the allies of my children; finally to have my works printed if I manage to complete them.”

“I am delighted to see your good spirit, but I realize, what I should have looked upon as evidence, that you will have the party against you, formidable at the Academy, lazy, yes, of people who believe only in their own health without even investing the trouble to open themselves, and whom being candidates of having given proofs of some strength, now merely do not want to look at the laughter of a centaur that has ‘roared in Munich’ ... and do not ask if there is, invention or not, advantage or not, on a gas machine [Sic.: dSV joking here on the invention of Deprez and his role in the development of electricity over large distances]. Yours dSV.”

In the Appendix of Letter 30, dated October 23, 1885, dSV writes to JB: “All my children and grandchildren have returned from their preparations to their cousins in the *Midi* or the *Auvergne*, from *Lourdes*. Today, I sign the distribution between them, of these goods, reserving my usufruct to maintain my house on a good foot, and to pay the costs of my publications. I ask for your prayers. Elizabeth [Sic.: One of his daughters] has a beautiful boy.”

In Letter 32, dated October 30, 1885, JB writes from his vacation at *Les Vans* the following to dSV: “Sir and dear Master. You do well, in my opinion, to finish getting rid of your children in their hands to care of business. Devote yourself now entirely to the things of science and those of heaven which, I believe, for us scientists, must be related intimately. If God fulfills my most ardent wishes, you will still have much time to complete your beautiful work, before you go into the womb of God where we can finally find some rest. In my moments of fatigue as now, I sometimes regret having so much to moan down here before I get there. Yet, there are too many reflections on this mysterious subject where we guide the deep but obscure clarity of faith.”

In Letter 53, dated November 20, 1885, JB proposes the following to dSV: “Sir and dear Master, although I may, to the great rigor, leave after tomorrow, Saturday, the holidays should not be declared on the 23rd and Mrs. Boussinesq, having a remnant of bronchitis that will take two or three days to cure, our departure for Paris is set for Tuesday 24. So we will be at the *Fénelon* Hotel on the evening of that day, and I could go to the members of the Section on Wednesday, November 25, which is the day when we meet with Mr. Lévy. Then, I will be at your disposal to come to your home in Vendome, if you deem it necessary. Yet, there would be a much simpler possibility. Since you have anyway to come to Paris, why can't you either take the most convenient day train to Paris on Wednesday, Thursday, Thursday, 26th or Friday 27th? I'll wait for you at Orleans Station at the designated time, and take you to the *Fénelon* Hotel, where you'll stay at least until Tuesday the 1st. You would find, on arrival, a good fire that we would maintain until you leave and a good bed. Mr. Raoul de St. Venant could come and pick you up only on Tuesday, or not even at all, because I would accompany you to the Orleans Station and he would wait for you at the Vendome Station.”

“So we arrive, without any inconveniences on your part, since you will have to make the trip anyway, about four days to screen the part of your Report that appears as too profuse. And even if you are strict, what would prevent you from reading to the Section only the part that would be complete, and putting in Paris itself, the last hand to the remainder during the week between the declaration of holidays and the presentation? I assume, in fact, that you would not delay the declaration of holidays beyond Monday, November 30th, which will bring the election to a meeting on December 14th or 21st. Consider that it's eight months since Mr. Rolland died. In this way, you would also have more time to see your colleagues, and your opinion would certainly weigh more in the balance than if you opened the complete text only at the last moment, after having talked with each other, they would have agreed and would, in essence, stop all what they intended to do. And Mrs. Boussinesq would look after your health, so that Mr. Raoul might be quiet.”

“In the meantime, you can copy the entire part of your Report that remains to be done, as it was in 1883 or that you may have already written these days. And it will be easy for you, in Paris itself, to complete or intersperse the remaining part. Don't worry, and call the Section for the 30th. If you were not completely ready that day, what would stop you from meeting towards the end of the week? And you would stay in Paris until Tuesday, December 8th. I would invite you, as you have done for us in 1871 and 1880 to Vendome. You would give us back the visits we have made to you twice. Certainly, it will not be the terms of the Report that will make you change your ranking. So there is no need for them to be fully copied and ready from the day of the holyday declaration.”

As stated by Hager *et al.* [2], dSV wrote his last letter to JB on December 10, 1885. JB answered one day later: a long correspondence between the two thus had come to an end.

Obituaries on dSV

There are several obituaries available on one of the greatest engineers of the 19th century. The obituary presented below was written by Edouard Phillips (1821–1889), a fellow member of dSV at the *Académie des sciences* and professor of mechanics at the *Ecole polytechnique* and at the *Ecole centrale*. It is titled “Notice on Mr. de Saint-Venant and on his works,” available at the *Comptes rendus de l'Académie des sciences*, volume 102 of the session held on January 18, 1886, reading: “In the midst of the recent and numerous losses that have plagued the Academy of Sciences, the Mechanical Section has been particularly afflicted. The death of its illustrious late Dean, Mr. de Saint-Venant, brings to three the number of Members of this Section who have been removed from us within less than a year. This painful event is due to the spirit of duty that animated our Brother, for it was during a trip to Paris, on the occasion of the election that will take place in our Section that he was afflicted with a cooling from which resulted the disease to which he succumbed on the 6th of this month.”

“Mr. Barré de Saint-Venant (*Adhémar*-Jean-Claude) was born at *Villiers-en-Bière* (Department Seine and Marne) on August 23, 1797. In 1813, at the age of sixteen, he entered *Ecole Polytechnique*, where he had as his classmates two of our former brothers, Mr. Chasles [Sic.: Michel Chasles, 1793–1880, French mathematician] and Mr. Bienaymé [Sic.: Irénée-Jules Bienaymé, 1796–1878, French mathematician]. He then entered the Department of Powders and Saltpetres, changed into that of the Bridges and Roads, after having taken out the first position of his School of Application. For twenty-five years, as engineer of the Bridges and Roads, he engaged in work of serious practices. It was in this capacity that he was attached successively to a seaport, to the shipping channels of *Arles*, the *Nivernais*, and the *Ardennes*, which included important works of all kinds; to those of *Yonne* River, to those of the roads and bridges of several boroughs. He did not keep up with it. Thus he used a new foundation process in difficult terrain. He also pointed at the means that are now being implemented to carry out a vast agricultural transformation, that of the *Sologne*. His memoirs on the Agricultural Water were honored in 1849 with a medal from the Agriculture Society. In 1850, following a competition, he was appointed professor of rural engineering at the Agronomic Institute, which had just been founded in Versailles. He was also, due to the proposal of Coriolis, charged with lecturing at the School of Bridges and Roads. Finally, on 20 April 1868, he was elected a Member of the Academy of Sciences, replacing General Poncelet.”

“In 1848, when he was still young and attached, as chief engineer, to the works of the City of Paris, he retired and devoted himself exclusively to his taste for science, and mainly for the branch of mechanics, perhaps the most important and certainly one of the most difficult, the one that deals with the elasticity of the bodies and their resistance. It would be impossible to quote, alone by a simple cite, the many works of our late Brother. We need to limit ourselves to a brief presentation of the main works.”

“And first, on the occasion of his teaching at the School of Bridges and Roads, he had been led to notice that the bending of solid parts was necessarily accompanied by relative transverse and longitudinal movements which he called slips. These relative shifts contribute to ruptures or alterations in cohesion by increasing molecular spreads that must be maintained within careful limits. As a result, he gave a new non-break formula or equation based on this new element. The following year, 1839, Poncelet, in his course at the Faculty of Sciences in Paris, stated this resistance formula, which he described as ‘very remarkable’. And which he took the trouble to seek and give an elementary demonstration.”

The long passage on mechanical flexion is not detailed here. The obituary continues: “The admiration that Mr. de Saint-Venant never ceased to profess for the learned and conscientious work of his former master, Navier, who operated in the theory of resistance and elasticity of solids such a happy revolution, had led him to annotate the lessons. The result was a new edition of the Course of Navier, published in 1858, which formed an almost entirely new work, for the notes

of Mr. de Saint-Venant occupied a much larger space than the original text. Let us cite, among them, a complete history of the progress of the science of elasticity from the Middle Ages to the present day; important notes on the compression, the bend and the twist breakage; a general presentation of the principles of the elasticity theory. We must still mention two considerable appendices on the general expressions of elastic forces in solids, the classification of the various kinds of coefficients: their reducibility in the most general case. Then, this reducibility to two or one in the case of isotropy. Finally, he showed their reduction to six or three in primitively isotropic bodies, but which were permanently distorted by the temporary application of three strong uneven pressures or pulls in three rectangular directions. The latter case is very interesting for practice, as it includes bodies that have been deformed by forging, stretching or rolling, and is dealt with in a Memoir inserted in the 1863–64 volume of Mr. Liouville's *Journal of Mathematics*."

"The importance of the scientific work of our venerable Dean can be judged by the above words. Until the most advanced age, he retained the same vigor and intelligence and the same power of work. Although living far from us, he frequently remembered us by strong Communications which testified that age had not weakened his fine ideas and, a few days before succumbing, he signed from his bed the proof from a Note sent to the Academy. Not long ago he had the pain of losing the companion of his life; but he was left with the consolation of seeing a large family of children and grandchildren gathered around him. It was in their arms that he passed away, authentic to the religious faith he had always possessed. His life so long and complete, full of work and honor, is a noble example to follow for all those who have had the happiness to know him and who remain behind him."

A second obituary was presented by JB himself at the grave of dSV on January 9, 1886, at Vendome, present in MS 4221 of the Library of the *Académie*, reading: "A few words about the life and work of Mr. de Saint-Venant, Member of the Institute, by Mr. J. Boussinesq, Member of the Institute. On Wednesday, January 6, at five o'clock in the evening, the deep surveyor engineer, a Christian no less eminent, who had long since established his residence among us (i.e. near of Vendome), Mr. Adhémar-Jean-Claude Barré de Saint-Venant, Dean of the Mechanical Section of the *Institut de France*, member of the Roman Academy of Sciences *dei Lincei*, the Royal Society of *Göttingen*, the Academies of Manchester, Brussels, Leuven etc."

"Born on August 23, 1797, at the *Château de Fortoiseau*, near *Melun*, to a father, himself a learned agronomist, former officer and settler of Santo Domingo, he had made classical studies at the high school of the Flemish city of Bruges, then reunited with the French Empire. At age fifteen, he had become a pupil of the *Ecole Polytechnique*, which he left as the first of his division, and where he had as his comrades the great promoter of pure geometry in our time, the late Mr. Chasles, as well as the illustrious experimenter General Morin, organizer of the Conservatory of Arts and Crafts. After a short service as an engineer of powders and saltpeters, he entered the School of Bridges and Roads, the school in which he later took the chair of applied mechanics. Successively ordinary engineer, chief engineer in Paris, creator, in 1850, of the Course of Rural Engineering at the National Agricultural Institute of Versailles, knighted, then officer of the Legion of Honor, he was finally elected, in 1868, member of the Academy of Sciences, replacing General Poncelet."

"A persevering work, guided by the glance of the genius who discerns and unravels the elements of the questions, allowed him to successfully address, in the course of his long career, almost all problems of science and natural philosophy that relate to the vast art of the engineer. It would be inappropriate to recall here, even briefly, the results of so much research, covering a wide variety of topics, but all of them being interesting. This analysis will be the subject of a Notice prepared by two of his disciples [Sic.: The obituary by Boussinesq and Flamant [4] in parts addressed below]. Let us say only a few words of those who have occupied him the longest, and where he has dug, in a new way, his deepest and most extensive furrow."

“They relate to a crucial question of applied mechanics, the study of the deformations and pressures that parts of buildings or machines are subject to efforts to flex or twist them, a study on which the calculation is based on the dimensions that these parts must have to resist. Getting rid of half geometric, half-empirical, and simply approximate hypotheses, on which the theories of bending and twisting of these pieces, whose shape is generally elongated, Mr. de Saint-Venant had been built up to him, inferred them from the general, elementary principles of the science of the elasticity of solids, which allowed him to express by his formulas, in flexion, ancillary phenomena of extreme delicacy, which had hitherto evaded the efforts of the researchers, and above all create from scratch the general theory of twisting, for which a superficial induction, of which we had contented, had done, except for a very simple case, entirely wrong results.”

After giving further details on Saint-Venant’s work in the above field, JB continues as follows: “There are few scholars, even first-rate ones, who have the good fortune to associate their names with a fundamental truth, destined to pass through the centuries to enter the high scientific teaching of future generations! Mr. de Saint-Venant deserved this happiness, by his ardent devotion to the truth, by his constant work to discover it, which was the great passion of his life, and which he saw as a strict duty of his vocation. For him, in fact, the study of natural laws was the search, through the lights of reason, within the apparent disorder of things, of a deep and simple order, image and effect of the sovereign intelligence that his faith made him worship and love. And he felt that the scholar’s obligation, his mission here on earth, is to put in all his day these beautiful laws, to make them, at the same time, admire as a reflection of their author and turn to common utility.”

“Thus, never left inaccessible to these temptations of discouragement to which the best sometimes succumb, he was able to preserve, even in the most advanced age, all his youthful soul, an amazing plasticity of spirit, maintained by a continuous effort, and above all this perfect clarity or this correctness of thought, which blames the smallest deviations and allows us to penetrate into the depths of things.”

“One might not find another example of a surveyor, almost nonagenarian, continuing to keep abreast all the progress in such difficult problems, and to participate by writing papers like those read, on shocks of bars, the outflow of water from orifices, liquid waves, his colleagues from the Academy of Sciences, in the *Comptes rendus* of recent years, and even in the issue that appeared on January 2. For, toward the end of the breach, and ‘forward’, he did not experience failure, and signed, in his bed, in the midst of the fever that was to prevail a few days later, the proof of his last article.”

“He died as a victim of the academic duty, the results of a cooling, taken in a hotel room, on the morning of December 27, during a trip to Paris, despite the hard season, the preparatory work of an election in the Section of Mechanics of which he was the revered dean [Sic.: Namely the election process which finally JB won]. Its end was therefore the worthy crowning of such a life. He closed his eyes, having blessed his children and grandchildren tidy around him. His two sons, whom he had seen wounded both gloriously in 1870, on the battlefield of *Loigny*, defending the soil of the Fatherland, his two desolate daughters, worthy images of a companion he had just lost, whose dedication and intelligent contest, in the administration of his temporal affairs, he had for the study his full freedom of mind: all of them, faithful to the principles of faith and honor that had guided him and which he had been able to instill in them from their childhood.”

“His death was as uplifting and serene as his life had been, holy and innocent. He had the good fortune to fall asleep from the last sleep, his soul imbued with immortal hopes, which doubt had never tarnished, and without which existence would be nothing but bitter irony and cruel disappointment.”

“Mr. de Saint-Venant was the honor of the Corps of Bridges and Roads, and one of the scientific glories of France. He belonged to this noble race of spirits, at the same time strength, ornament

and consolation of our species who, together or isolated, leave after them, in history, a luminous trail, to which new intelligences are constantly lit to form an ever-larger current of true and high civilization.”

“These few lines were intended to give an idea of the scholar which he represented. There will also be the chance, some day, to make the philosopher known, and to show how much this man of faith believed in the power of reason, how bold of ideas he knew how to bring, for example, to the difficult problems of the constitution of matter and the nature of the forces that move. Yet, only his disciples and friends will know, without being able to express sufficiently, how rich his heart was full of affection, delicate thoughtfulness, and this rare devotion which does not cost anything.”

Another note of interest is dSV’s scientific work, which finally led to his election to the Section of Mechanics in 1868. It is also present in MS 4221 of the Library of the *Académie* and reads: “The purpose of this Notice is to support my application for the vacant position in the Mechanical Section of the Academy of Sciences.”

“Please allow me first to state that it is not only as an author of some Memoirs that I present myself, it is also as a man of practice, as an engineer who has seen and listened to a lot. I have been attached successively to the General Council of Bridges and Roads, to a seaport, to the shipping canals of *Arles*, the *Nivernais*, the *Ardennes*, to the works of Yonne River, to those of the roads and bridges of several boroughs, to those of the city of Paris, a drying up of marshes, the school of Bridges and Roads, and finally to the Commission charged with preparing a new law on rolling (it is, no doubt, as the author of two memoirs addressed to the administration on this subject, and accompanied by weighing machine projects, which I have been called upon to sit in this Commission, almost entirely composed of corps inspectors), as well as that of articulated cars. I have made many trips and collected many documents on my topics. Perhaps, therefore, we will think that the issues that are related to it, and which are frequently mixed with those before the Academy, are important.”

In the following, only selected passages of this Notice are reproduced; they read: “Memoir on an interpolation method applicable to water movement, and an alternative for the often impossible integration of equations with partial derivatives. In this Memoir (see *Comptes rendus*, vol. XVII, 1843, 1108–1115) I propose a practical goal. The integral equations, of which I have numerically determined the coefficients, exactly satisfy an equation with partial derivatives for all points of a fluid section, as well as the conditions defined for certain contour points, and they meet roughly the same conditions for the other points, so that I believe this way of operating applies to the solution of many problems of usual mechanics, in cases where rigorous methods of integration do not exist.”

In hydraulics, the following papers are considered essential for the advancement of dSV’s career.

“Note to add the Memoir on fluid dynamics (*Comptes rendus* 27.11.1843, vol. XVII, 1240–1243). The author demonstrates, among other things, that (1) the mutual friction of two fluid layers is equal to the living half-force [Sic.: 50% of the kinetic energy] due to the molecular movements alien to translation, which are generated there while one travels through the space unit relative to the other; (2) that the Navier and Poisson equations for the fluid movement can be established directly by only assuming that ‘there is no friction in directions where there is no relative slippage’. These equations appear to apply only to very regular movements. As for the flow in streams where there are many swirls, it can be subject to other laws, for the discovery of which the author proposes a program of observations, adopted by various experimenters.”

“Theorems on the friction or action of fluids moving evenly and straightly through channels or prismatic pipes (*Société philomatique de Paris*, April 4th, 1845, 49–52; or *L’Institut* No. 641, 1846). The author gives expressions for the intensity of the forces in question, at various points

of very wide channels or circular pipes, indicated as theatres of speed-measuring experiments to determine the relations between the two.”

“Memoirs and experiments on air flow determined by considerable pressure differences, by B. de Saint-Venant, A. and Wantzel, P.-L. (*Comptes rendus*, 25 February, 1839, vol. VIII, 294–298, also printed in the *Journal de l’Ecole polytechnique*, XXVII, 1839, 85–122); and further New experiments, by the same authors (*Comptes rendus*, 13 November, 1843, vol. XVII, 1440–1142). These experiments were conducted to recognize what should be substituted for Navier’s logarithmic formula, based on the assumption of complete relaxation giving the gas the same density when it passes through the orifice and into the space.”

“On a method applicable to water flow issues (*Comptes rendus*, 13 November, 1843, vol. XVII, 1108–1115). The author attempts to supplement expeditiously and practically, by some kind of interpolation, the integration of the equation with partial differences of Navier for fluid movement. The integration is not possible by known methods if the conditions to be met at the boundaries, i.e. against the wall of a current, are not linear.”

“Note on the theory of air flow (*Société philomatique*, August 30, 1845, p. 101; or *L’Institut*, N° 611). To assess the total friction of a pipe wall, Navier assumed that the square of the pressure decreased evenly from one end to the other. The author replaces this hypothesis with another equally plausible and simpler, and better suited idea to the facts.”

The Library of the Académie hosts in addition a complete set of all published and unpublished works of dSV. It includes 25 publications of a certain extension, 136 papers published in the *Comptes rendus* or in the *Bulletin de la Société Philomatique*, 5 papers published posthumously, and 18 otherwise published memoirs.

JB’s contact with Raoul de Saint-Venant

Raoul dSV, the eldest son of dSV, writes to JB on December 29, 1885, the following message: “Dear Sir, I will give you news of my father that you must have waited for with whatever impatience. The evil is serious and the doctor pronounces the word ‘chest flow’. The point attacked in the siding, it is true, is restricted, but such a disease at the age of my father is nevertheless very serious, and we are very worried. However, his constitution is so rigorous that he may be able to overcome evil. However, he is extremely weak. He is treated with milk, broth and from hour to hour a spoonful of rum mixed with water. He lets himself be treated admirably, he was changed from his room to a larger one with a better bed. He’s fine. I watched him last night, he made no difficulty in making his character become sweet as that of a sheep. Of course, don’t count on him on Monday. I do not know anything, whether he will be able to vote, to finalize what he wanted to do, which I hope. Please pay my respects to Mrs. Boussinesq and believe in my feelings, the best and friendliest Raoul dSV.

P.S. The doctor left at 10 AM, he is more satisfied with the general condition, it keeps me a little better, and gives us hope.”

A second letter from Raoul dSV was written on January 1, 1886, stating: “Dear Sir and friend, my father’s situation is about the same as yesterday and the day before yesterday. The disease does not make progress but the weakness is extreme. We support our poor patient with broth, milk and rum, and we remain hopeful that his exceptional nature will triumph over evil, but the situation is serious because of his age. Then, he doesn’t let himself be treated easily, he is so unaccustomed to it, we will have to get him to give up his trip on Monday. Today he was changed from his bed to another. In his well-heated room (20 degrees) he tried to put his feet on the ground, but his weakness is so severe that he could not support himself. He realizes how hopeless his travel plan is. He does not know that his illness is a chest flow and believes in a simple bronchitis. In his moments of great absence, he works aloud with you, but only on the evening to untie because it

is to us that he addresses and says: ‘I want to do this with Boussinesq because of this and that’. He hasn’t lost his mind for a single day, but his word is confused and his tongue pasty. I sent a letter on his order to Gauthier-Villars for his corrections, your letters that arrived at the same time today. We criticize that this was unnecessary. Tomorrow I will write to Mr. Philipps and send him the text that my father was to read on Monday and ask him to do it for him. His own idea was that I should accompany him to the meeting and you should read in his place, claiming that you act as a *prendeur* [Sic.: a laborer in the Middle Ages who agreed to cultivate land owned by a lessor in exchange for ownership of the crop and its production].”

“It is not necessary to hide the serious situation, and we thought we had to gather my distant brothers and sisters. I will send you more news tomorrow. Thank you very much for the housewife’s commissions. Goodbye dear Sir, thank you for your feelings about my poor father. Pay my respects to Mrs. Boussinesq and believe in my affection, Raoul dSV.”

The next letter of Raoul dSV to JB was sent on January 3, 1886, reading: “Dear Sir, I cannot give you, alas!, very good news today. My poor father is weakening enormously and in such a way that the priest thought he had to put the Good Lord on him tonight at four o’clock. He received it in full knowledge and did not lose his ideas for a moment. However, he did not take into account his condition. He confuses the hours and the long nights make him confuse the evening with the morning. We had to write to Mr. Fizeau [Sic.: Hippolyte Fizeau, 1819–1896, French physicist] to ask him to read your report. But it seemed to me that Mr. Fizeau was not from the Section [Sic.: of Mechanics]. Rather, it was necessary for Mr. Philipps to take care of it. In my ignorance of the things of the Academy, I was embarrassed and I wrote two letters, one to Mr. Fizeau to whom I sent the Report and attached to this letter, one to Mr. Philipps, of whose address I was not sure. I said to Mr. Fizeau that my father appears to have a colleague in him, but that it may be certain that a member of other Sections will present the candidates in this way, that in this case I ask him to hand over my letter and the Reports to Mr. Philipps.”

“My letter to Mr. Philipps explains to him the conditions of my father and asks him to make this reading, and if it is not necessary, to give it to Mr. Fizeau. In addition, he dictated to my sister Genevieve a letter for Mr. Fizeau, a letter of which I send a copy to you to show you how his head is still well operating.”

“Tonight the doctor noticed a slight improvement, almost no fever, but very great weakness and no sputum. Tomorrow it will be most critical. The horizontal position causes congestion of the lungs. No way to forget these drawbacks. In short, we are horribly worried: my brother will arrive tonight, my sister from Puytison arrived last night and we are all around him for this solemn moment. How sad and painful it is to see your dearest die! For it must be admitted, he is very bad and the doctor sets to lose hope of saving him.”

“You sympathize well with our pain, you whom he loved as a son. Ask God that he will have to preserve him at least until he has the joy of seeing you arrive at the Academy. He could still sing his *Nunc dimittis* [Sic.: the song of Simeon, dealing with the farewell from life] the work of the fire of his life would be accomplished. Farewell, then, dear Sir, my respects to Mrs. Boussinesq and for you my best feelings, Raoul dSV.”

The next letter was written by Raoul dSV to JB on January 5, 1886, reading: “Alas, alas, dear Sir and Friend, no hope, absolutely no hope to prolong this life so dear to us as to you, as you have given in testimonies.”

“He was administered today at 5 o’clock with a well-awareness of the sacrament. He then blessed us all as the serious patriarch amidst of his children’s speaking aloud, in a very intelligible way, asking God’s forgiveness for his faults, then he uttered some prayers, without much follow-up and for two hours rested calmly, half-ajar eyes and had this breathless and oppressed breath. One would think that he is leaving without any suffering. He almost doesn’t cough. But the lungs are getting more and more involved and make us fear that he will not see the sun rise tomorrow.

You understand our despair. And mine for not having treated him more and let him go yesterday at Mr. Becquerel's house and especially for not having warned him in the morning when he woke up not to light his fire. Yet we were so unaccustomed to treating him! He was so vigorous! It doesn't matter, receive this heavy idea like a sermon of my confidence."

"Tomorrow you will probably receive a letter that announces to you the end. You understand our grief and we know that you are pre-watching it. Thank you for being here, pass to Mrs. Boussinesq the feelings she shows us, Raoul dSV."

At 6 o'clock in the evening of January 6, 1886, Raoul dSV writes to JB: "Dear Sir and Friend, it's over. The one you liked to call your venerable master to give the last sigh just now at 5 o'clock in the midst of all his children, a true patriarch. What an uplifting death! What an admirable life! How many virtues, how much faith, what hope, what charity! And that work duty dies of self-recognition. May the immense example for his descendants weep with us as his sons, with also his poor, grieved daughters, whom he loved and who venerated him! We don't know when the funeral will be held, the time is too close where he has given the last sigh, but I'll let you know."

"In case you are healthy you will wish to come and see him, you will have with us, perhaps not a night cottage, because of the large number of parents whom we will be forced to receive, but a table to cure your strength after the ceremony. Yours at heart, you who loved my father so much, Raoul dSV."

The following letter was written by Raoul dSV to JB on January 10, 1886, reading: "Dear friend, Mrs. Boussinesq did well to keep the dispatch that I had sent you, so great was our desire to have you with us to return the last duties to our excellent father who loved yourself as a son. The horrible weather on Friday evening and the great cold that followed it on Saturday night were such that we could have blamed ourselves for having caused to my father's true friends some misfortune. So, we would have only our close neighbors and relatives for this sad ceremony that happened bleakly, with a fairly large crowd of people both of Vendome and the surrounding area, and a dozen pedestrians. Your devoted and grateful friend, Raoul dSV."

Although no letters, written during this period by JB, are present in the Correspondence, Raoul dSV wrote another on January 13, 1886, stating: "Dear and worthy friend, I thank you again for the feelings you expressed to me about the cruel loss I have just experienced, but what do I say? Do I need to thank you? Aren't you a brother to us? Aren't you the scientific son of our deceased loved one? And is it believable that he's dead? Is this letter bearing a writing so well known to me that passes in front of my eyes several times a week to reach up there to the cell [Sic.: expression for the work room of dSV] of the saint and the scholar? Alas, what sadness in this world under the sharing of the attached to the earth called humans!"

"Present success from room to room we go with an estimate to judge the furniture of which each is an anecdote in the history of the family. And how else? My brothers and sisters have even left the objects with care since they were children. It is only natural that they want to have their share. Yet, it does not matter, if it is possible, after me, we will not share among all the children the furniture of the house. Everyone will have a memory, and the elder in turn, diminished by little things. However, let's chase those thoughts. I hope to receive one or more copies of Mr. Philipps' report on my father, and I think the rule is to do the same."

"I am sending you your corrected and edited speech, somewhat modified, so that you can add what you want. We will not publish it until you have returned it to us. I send it to you in several copies so that you make all the corrections and annotations you want."

"In this regard, if on Monday you will be elected, as is likely, although you did not speak to me on your new chances in your letter, allow yourself, however, to put in front, 'the speech delivered on the grave of Mr. de St. Venant by Mr. Boussinesq, Member of the Institute'. Our friends and neighbors know, it is true, that you were not here, but they do not know that a scientist from Paris, who had not been able to attend the sermon, had sent this speech which was read by one

of our friends. Without it, we would put what we were taking. You can count on the fifteen copies you asked for, and I would make it if you send me the list of people to whom you wish to give it, except if they are from my birth year or scholars, so that there is no duplication.”

“My brother and I will do everything we can to find what you ask for from my father’s papers. We have already begun to classify all the papers and books that lined his cell, but it is a great job and we will take a long time to carry it out. Besides, we are so afraid of throwing away something precious that we have the tendency to keep more than less. You will do all this when you come, because I see with joy that you can arrange your affairs so that we can dedicate your Easter holidays. It may not be too much all week to get this job done. But we’re going to prepare it for you.”

“I am not surprised that there is not a perfect match between the Easter dates by us and those found by Mr. Philipps. We will not be able to write to get our hands on the analysis of my father’s titles. But it is done now and we are in the position of anyone for any information about it. I will send the 10 francs to Mr. Mehl, if he will send me his address.”

“I have received some very good letters about the sad event that overwhelms us, one of Mr. Sulamme who appears to have always been a faithful friend. Then another from Mr. Hyenne, who asks for a photograph of my father with whom he was in correspondence about St. Bénézet. Do you have any yourself? Goodbye dear friend, I am obliged to return to my unfortunate sharing operations. Please pay my respects to the good Mrs. Boussinesq and believe in my lively and sincere feelings, Raoul dSV.

P.S. If you are elected, I count on a telegram on Monday evening by the Post Office of Vendome, we would have it the next morning by the postman.”

Another letter was written by Raoul dSV to JB on January 18, 1886, stating: “Dear Sir and Friend, you must think about how much my family and I are taking part in the legitimate joy that you must feel in such a serious and happy circumstance for you. Ah, what is there for my father to exalt himself? It could be that the purpose of his life is now fulfilled, because really for many years, your election was most at his heart. I had heard this morning in Vendome by a newspaper, that chance put me on hand. Then coming back here I found my whole family as happy as the success to be named can allow. What a mixed joy indeed! See my father’s work accomplished and no longer have it with us to witness it!”

“In any case, my wife, brother, sisters and brothers-in-law meet to congratulate you very highly, dear and worthy friend. You have had higher thoughts for the successful merit to fulfill properly the role that providence and also fortune gives you. And you are not ungrateful, you give back to my father’s memory the justice to grant him a great deal in the necessity of your election. And we, in accordance that you will not fail to help us and support us in the work that we have the desire to undertake, namely the highlighting of the works, and in general of the life and great character of our father.”

“We hope to see you now more often, no doubt you will be appointed to a chair in Paris, for it would be unfortunate if you were as far away from your seat as my father was, old and retired. And then Vendome’s trip will present itself as a holiday distraction for all. Just like us, when I go to Paris, I would not fail to spend a few moments with you who are dear to me as the eldest son so proud of our father.”

“We are always here in the bad and very sad moment of sharing all the furniture, even books of the family. For generations! It’s sad for me, but there’s nothing we can do about it. It was God who wanted us to be born. This is my brother who left because of service. He will be back in a few days. Then my sister from Puytison will also leave in two days. She has to go back to her little boy. Finally, we’re going to have to find ourselves in this empty house, the revered sous chef. You would be good to tell me whom to send the ticket to pass at the *Institut*. If I followed my instincts, I would send it to Mr. Bertrand, but what is the point of digging between the Perpetual Secretary and the President? The same goes for academies or learned societies abroad and in the province.”

“We continue to make our efforts to clear up my father’s many papers. But we can see that without you, we will never get there. So we limit ourselves to putting aside all the manuscripts that you will classify when you come, depending on what your memories and the great knowledge you have of my father’s work will indicate to you, because we intend to have them all edited. It remains to be seen to what extent the Academy will help us to support in this task. Goodbye, dear and illustrious friend, please pass to Mrs. Boussinesq my tributes, and the compliments from Mrs. de Saint-Venant and my sisters, that all cordial congratulations and believe in my very sincere affections, Raoul dSV.”

Another letter written on April 29, 1886, by Raoul dSV to JB reads: “I hope you do not forget your promise to come and see us and help in the Easter week. Everything now seems to me in a position to receive you, yet it is difficult for me to put away by date the various manuscripts of our father, since some are undated. Yet, thanks to what you know perfectly well about the work, you will certainly be able to fill these gaps. Bring clothes that the dust doesn’t fear, because this poor room you know well is the most incredible nest of old father. And that would be the case until I was able to do some very serious work there. My dear father was used to it and really didn’t pay attention to it. For me, I have an *ad hoc* garment to enter.”

“I had by Mr. Becquerel [Sic.: Henri Becquerel, 1852–1908, French physicist], Mr. Pingard [Sic.: Antonius Pingard, 1797–1885, special agent of the *Institut*] and others the desired information about the bust [Sic.: of dSV] which we plan to order. We’re probably going to address the one the governor has in charge of Pinel’s bust. We are discussing this, like many other things, during your stay here. Mr. de Caligny [Sic.: Anatole de Caligny, 1811–1892, French hydraulician] has sent me letters and even the writing of a note that he asks me to submit to you. You’ll tell me what I should say to him.”

“Mrs. de Saint-Venant is pleased to receive Mrs. Boussinesq whose goodness is well known, both by the supports made to him [Sic.: dSV] by my parents and by what I told him myself. I also expect you’ll see my brother and he can come and spend two or three days with us. I am very happy myself with the prospect of having you here, I only regret that your stay is so short. So, see you soon, dear friend, please pay my respects to Mrs. Boussinesq and believe in very affectionate and devoted feelings, Raoul.”

The last letter written by Raoul dSV to JB is dated June 27, 1887, i.e. more than one year after the above letter, and reads: “My dear friend, I took care of the various manuscripts of my father that you asked me for, and I got my hands on the book *La houle et le clapotis* [Sic.: The swell and the splash] written in 1878. As for the record on Chézy, it does exist but very short in the work of *St. Bénézet* [Sic.: a saint of the Catholic Church having lived from 1163 to 1184; he is considered the founder of the bridge building brotherhood]. I have not yet found the manuscript, perhaps it will be interesting indeed to publish it because my father was pretty much limited to give a list of his various works.”

“As to the hydraulic files, I am unfortunately certain that I have dispersed the elements, as well as all the other files that have fallen in my hands, I imagine that it would be impossible to complete all this work that just begun. I regret it today.”

“Since you have seen my brother, you have probably communicated to him your thoughts about my father’s intentions on the publishing of his books. It has always been figured that my father would have wanted not only to bring his works together into one unity, but also to have them edited again and brought together into an assemblage of body-forming volumes as was done for Cauchy and Lagrange.”

“I think we can simply put together the various elements that have passed in different collections and give them in a presentable form. It is, I know, your idea and you must have explained it to him more lucidly and it is evident that I could do it. One day or another, you would have to take the trouble to come and visit me again with Mrs. Boussinesq, and you can then delve at leisure

into these manuscripts that I have stored by year, but in which despite this it was very difficult to succeed, at least for me. You will obviously be able to extract something of interest from it. It seems to me that this little trip would be easy for you, for example when you return from the *Vans*, when you have finished your exams. At that time, the temperature is generally most favorable to you and to Mrs. Boussinesq.”

“Thank you for giving me a few copies of the off-print run of *The fluid resistance* [Sic.: whose first edition was published with the support of JB in 1888]. I think 15 would be enough for me, because I do send them only to family members. If you should send the notice *Sur la houle et le clapotis*, I would ask you to see it again. No, I will always send it to you, you would give it to Mr. Flamant if you think it appropriate. I will only keep it, to take it to you on my next trip to Paris, a bundle of papers presenting the plans and profiles of the course of Garonne River. However, I have so far not discovered any related text. There may not be any. I’m going to look for it again. I regret that your memoir did not provide you with the year of the composition of this file, for it would facilitate my research. Nevertheless, I repeat, for this and the other things, I ask for your visit one day or the other.”

“I am pleased to hear that Mrs. Boussinesq has finally cleared or pretty much got rid of her persistent cold. And I have the satisfaction of giving you only good news of mine, despite the fatigue of the mother of the family and a small health attack of various children. So, in 19 days, we leave for *Rogan*, all of us, to profit from the good sea air because what one is breathing here is too weak. We will stay there until the end of August. It is also in this way that I sometimes receive the serious efforts of my eldest son, who, as everyone has said that my brother is much more diligent at work these days. Please pay my respect to Mrs. Boussinesq from whom Mrs. de Saint-Venant wishes not to be forgotten, and receive yourself the new assurance of my sincere friendship and my deep gratitude, Raoul dSV.”

This is the last letter available in the Correspondence. It should be repeated here that JB supported largely the publication of five works initiated by dSV, the last being published in 1888. As noted above, Raoul dSV intended to publish “all works” of dSV. This was certainly a too heavy load for JB so that he will have stopped after these additions. It is also notable that the last letter of Raoul dSV was written in mid-1887, i.e. 18 months after dSV’s passing. The present authors do not know whether there was further contact between the two families; so the entire Correspondence had most probably concluded by then.

Letter of Mr. André Neveu to first author

Villeporcher, Thursday June 14, 2001

André Neveu
56 Rue Barré de Saint-Venant
F-41 100 Saint Ouen

Dear Sir, I was very pleased to have you on the phone and I was even more pleased to receive the letter you sent to me so quickly. I send you in this envelope a series of documents on Adhémar Barré de St. Venant, my wife’s direct ancestor and in whose beautiful house we live.

① Some portraits of the scientist. The largest of these photographs, unfortunately quite blurry, is probably the most realistic since it is a real photograph taken by a photographer of Vendome (Figure 2a). The second, by size, is that of the marble bust that is currently in the library of the *Ecole Polytechnique* in Massy-Palaiseau (Figure 3a). It is a bust of a beautiful finish. It was previously in Louveciennes, on the outskirts of Paris, in a property of the Academy of Sciences (Figure 3c). You also have the photograph of a stone bust, of mediocre design, placed in the entrance of the *Ecole des Ponts et Chaussées* in Paris (Figure 3b). Finally, I send you two prints of the same family portrait currently existing at The Castle of Valmer (Figure 2b) [Sic.: on the



Figure 2. (a) Photograph, (b) painting of dSV (private archive of WHH).

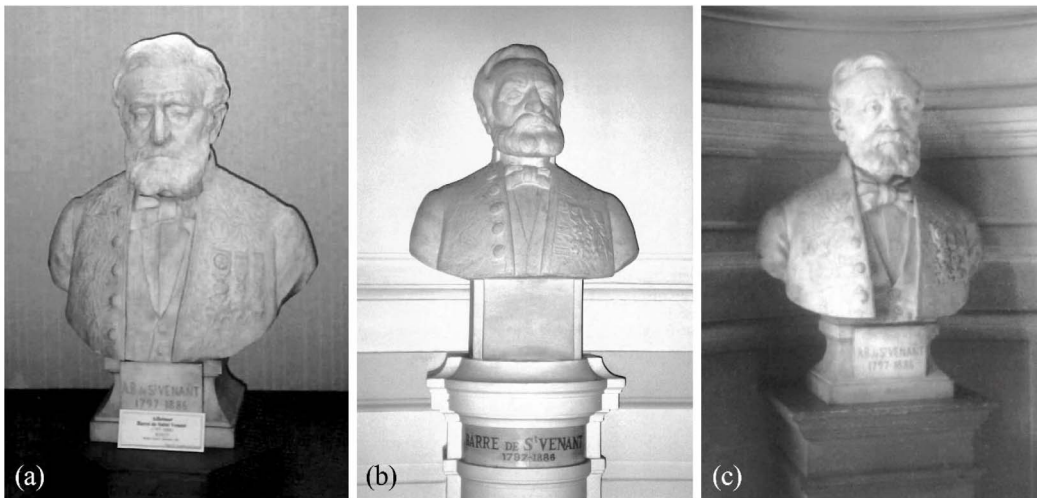


Figure 3. Busts of dSV at (a) *Ecole polytechnique*, (b) *Ecole des Ponts et Chaussées*, (c) *Louveciennes* (private archive of WHH).

Mediterranean between Marseille and Nice], where the old branch of the St. Venant currently lives.

② I attach two photographs of the house where St Venant made most of his theoretical scientific discoveries: this is the property of Villeporcher, where my wife and I live (Figure 4a). One of the photos shows you the house as he bought it and lived in it for years; the other shows you this same house in its current state.

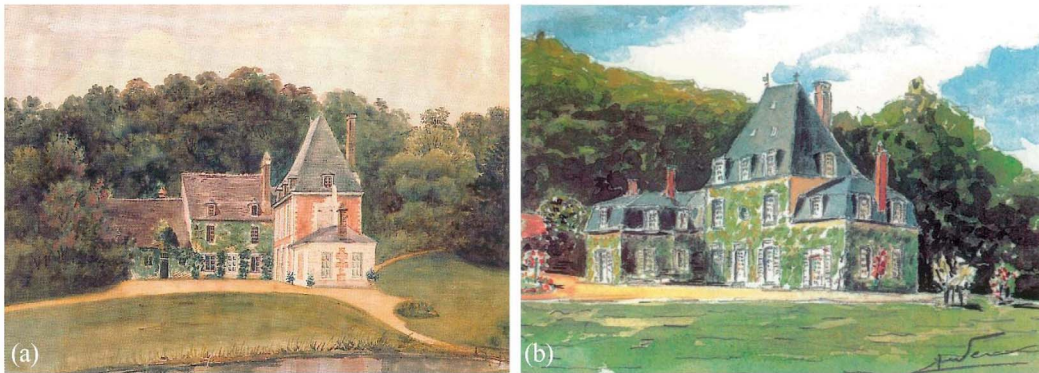


Figure 4. Castle of the dSV family at Villeporcher: paintings by (a) dSV, (b) A. Neveu (private archive of WHH).

③ That's not all. This is the only copy I have on the Fluid resistance of St. Venant, a 300-pages posthumous work published in 1887 (one year after the scientist's death) by the *Académie des Sciences*. I attach a document, which you can keep, published by SABIX in December 1992. It is an excellent synthesis booklet on the life of St. Venant. I confess that I would very much like to recover the 300-pages green document, having only one.

④ I would end by sending you the text of a plaque affixed to one of the two pillars of the entrance to our property. This text, affixed on November 15, 1986, for the centenary of his death, is as follows: "There are few scholars who have the pleasure of associating their name with a fundamental research destined through the centuries and entering the high scientific teaching of generations. In this house lived from 1855–1886

Adhémar Barré de Saint-Venant

Membre de l'Académie des Sciences

a physicist, mathematician and agronomist. His remarkable scientific work plays a key role in the latest applications of material resistance, fluid mechanics and in the field of aerodynamics, particularly aeronautics and aerospace."

I think, Sir, that you now have, with these documents, an overview of the life and work of St. Venant. Please do not hesitate to ask me if you want clarifications. I'll always do it if I can. Kind regards, André Neveu.

Conclusions

Given that both Adhémar Barré de Saint-Venant and Joseph Boussinesq count as outstanding scientists in the late 19th century, the Correspondence between the two is relevant in the understanding not only of their research but also in their human relationship. This work deals with the professional and private life of de Saint-Venant, who at the start of the Correspondence was just elected president of the Mechanics Section of the *Académie des sciences*, Paris, thereby taking over a top position in the academic world. After his contact with the much younger Boussinesq about a question on one of his first publications, the two started a nearly 20-year-long friendship. The Correspondence therefore does not only deal with technical questions but also highlights human successes and problems among many other issues. Accordingly, the reader is taken to the 19th century, thereby having a look at political, religious, and economic topics.

The two main actors profited immensely from each other. On the one hand, de Saint-Venant had turned 70 years old at the start of the Correspondence, but he was still active in scientific

developments such as in the setting of the shallow water equations in 1871. However, he felt the limits of his forces and therefore found in Boussinesq a person who was at the forefront of the advances in mathematics and physics. Often, therefore, the elder engaged the young scientist in computational details, in the solution of complicated equations, or in the demonstration of physical phenomena. On the other hand, Boussinesq had an auxiliary position as a teacher at a high school in the Savoy Alps, from where he could hardly access the scientific world in Paris. Saint-Venant was largely responsible for his shift as professor to the University of Lille in 1873 and finally to his entrance at the *Académie* in Paris. The election process followed less than 2 weeks after the passing of de Saint-Venant so that he could no longer see the fruits of a long process by which his scholar reached the highest academic degree within France.

This work also deals with the time after de Saint-Venant's passing. Given the many projects that had been started, his eldest son Raoul was able to bring some order to the estate. He therefore involved Boussinesq, the person knowing best the writings of his mentor, to finalize several of the scientific works, thereby publishing these. The Correspondence also deals with human losses at times including the Franco-Prussian War during which two sons of de Saint Venant were injured and the castle of de Saint Venant was occupied by the foreign forces. It also deals with the fate of his wife, who finally passed away before de Saint-Venant. It deals in addition with the delight of the grandfather Saint-Venant on the birth of his grandchildren and the human contacts between the two wives of the main actors. It finally presents paintings and photographs of the main actor given to the first author by the de Saint-Venant family. Accordingly, this third publication on the Correspondence adds to the widely known facts found in the scientific papers written by the two eminent scientists.

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