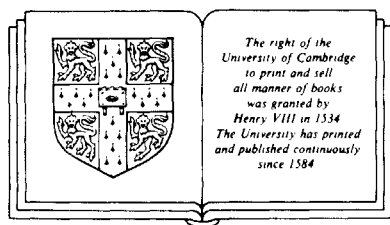


# The mechanism of human facial expression

by G.-B. Duchenne de Boulogne

*Edited and Translated by R. Andrew Cuthbertson*



Cambridge University Press

*Cambridge*

*New York Port Chester Melbourne Sydney*

Editions de la Maison des Sciences de L'Homme

*Paris*

*Studies in Emotion and Social Interaction*

This series is jointly published by the Cambridge University Press and the Editions de la Maison des Sciences de l'Homme, as part of the joint publishing agreement established in 1977 between the Fondation de la Maison des Sciences de l'Homme and the Syndics of the Cambridge University Press.

Cette collection est publiée en co-édition par Cambridge University Press et les Editions de la Maison des Sciences de l'Homme. Elle s'intègre dans le programme de co-édition établi en 1977 par la Fondation de la Maison des Sciences de l'Homme et les Syndics de Cambridge University Press.

Published by the Press Syndicate of the University of Cambridge  
The Pitt Building, Trumpington Street, Cambridge CB2 1RP  
40 West 20th Street, New York, NY 10011, USA  
10 Stamford Road, Oakleigh, Melbourne 3166, Australia

© Cambridge University Press 1990

First published 1990

*Library of Congress Cataloging-in-Publication Data*

Duchenne, G.-B. (Guillaume-Benjamin), 1806–1875.  
[Mécanisme de la physionomie humaine. English]  
The mechanism of human facial expression / by Duchenne de Boulogne  
edited and translated by R. Andrew Cuthbertson.  
p. cm. – (Studies in emotion and social interaction)  
Translation of: Mécanisme de la physionomie humaine.  
ISBN 0-521-36392-6  
1. Facial expression – Physiological aspects. 2. Face – Muscles.  
I. Cuthbertson, R. Andrew. II. Title. III. Series.  
QP327.D8313 1990  
612'.92 – dc20

89-77825  
CIP

*British Library Cataloguing in Publication Data*

Boulogne, G.-B. Duchenne de  
The mechanism of human facial expression. – (Studies in  
emotion and social interaction).  
1. Man. Facial expressions  
I. Title II. Cuthbertson, R. Andrew III. Series.  
IV. Mécanisme de la physionomie humaine. *English*  
152.4

ISBN 0-521-36392-6 hardback

Transferred to digital printing 2003

# Contents

Acknowledgments	xiii
Contributors	xiv
Editor's Preface	xv
Part 1: The mechanism of human facial expression or an electrophysiological analysis of the expression of the emotions	
Preface	1
<b>A. Introduction</b>	<b>3</b>
<b>Chapter 1. A review of previous work on muscle action in facial expression</b>	<b>3</b>
I. A historical survey	3
II. Critical consideration of the various means of investigation used in myology	6
III. The background to my electrophysiological research on facial expression in movement	9
<b>Chapter 2. Principal facts that emerge from my electrophys- iological experiments</b>	<b>12</b>
I. Isolated contractions of the muscles of the face	12
II. Combined contractions of the muscles of the face	16
III. The muscular synergy of the expressive movements of the face	18
<b>Chapter 3. The reliability of these experiments</b>	<b>20</b>
<b>Chapter 4. The purpose of my research</b>	<b>22</b>
I. The application to anatomy and physiology	22

II. The application to psychology	24
III. The application to painting and sculpture	32
IV. A plan for the exposition of these studies	36
<b>B. Scientific section</b>	39
Foreword	39
<b>Chapter 5. Anatomical preparations, and portraits of the subjects who underwent electrophysiological experiments</b>	42
Captions to Plates 1, 2a, 2b, 3, 4, 5, 6	42
Further notes on these plates	42
<b>Chapter 6. The muscle of attention (<i>m. frontalis</i>)</b>	49
Captions to Plates 7, 8, 9, 10, 11	49
Further notes on these plates	49
<b>Chapter 7. The muscle of reflection (superior part of <i>m. orbicularis oculi</i>, that part of the muscle called the sphincter of the eyelids)</b>	52
Captions to Plates 12, 13, 14, 15	52
Further notes on these plates	52
<b>Chapter 8. The muscle of aggression (<i>m. procerus</i>)</b>	56
Captions to Plates 16, 17, 18	56
Further notes on these plates	56
<b>Chapter 9. The muscle of pain (<i>m. corrugator supercilii</i>)</b>	60
Captions to Plates 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29	60
Further notes on these plates	61
<b>Chapter 10. The muscles of joy and benevolence (<i>m. zygomaticus major</i> and the inferior part of <i>m. orbicularis oculi</i>)</b>	69
Captions to Plates 30, 31, 32, 33, 34, 35, 36	69
Further notes on these plates	70

<b>Chapter 11. The muscle of lasciviousness (transverse part of <i>m. nasalis</i>)</b>	74
Captions to Plates 37, 38, 39, 40, 41, 42	74
Further notes on these plates	74
<b>Chapter 12. The muscle of sadness (<i>m. depressor anguli oris</i>)</b>	78
Captions to Plates 43, 44, 45	78
Further notes on these plates	78
<b>Chapter 13. The muscles of weeping and whimpering (<i>m. zygomaticus minor</i> and <i>m. levator labii superioris</i>)</b>	81
Captions to Plates 46, 47, 48, 49, 50, 51, 52, 53	81
Further notes on these plates	82
<b>Chapter 14. The muscles complementary to surprise (muscles that lower the mandible)</b>	87
Captions to Plates 54, 55, 56, 57	87
Further notes on these plates	87
<b>Chapter 15. The muscle of fright, of terror (<i>m. platysma</i>)</b>	89
Captions to Plates 58, 59, 60, 61, 62, 63, 64, 65	89
Further notes on these plates	89
<b>Chapter 16. A critical study of several antiquities from the point of view of <i>m. corrugator supercilii</i> and <i>m. frontalis</i></b>	93
Captions to Plates 66, 67, 68, 69, 70, 71, 72, 73	93
Further notes on these plates	93
<b>C. Aesthetic section</b>	101
Foreword	101
<b>Chapter 17. Aesthetic electrophysiological studies on the mechanism of human facial expression</b>	104
Captions to Plates 74, 75, 76, 77, 78	104
Further notes on these plates	105

<b>Chapter 18. Further aesthetic electrophysiological studies</b>	114
Captions to Plates 79, 80, 81, 82, 83, 84	114
Further notes on these plates	114
The Plates	129
<b>Chapter 19. Synoptic table on the plates of the Album</b>	211
Synoptic Plates	213
Part 2: Commentary chapters	
<b>Chapter 1. The highly original Dr. Duchenne</b>	225
R. Andrew Cuthbertson	
<b>Chapter 2. The Duchenne de Boulogne Collection in The Department of Morphology, L'École Nationale Supérieure des Beaux Arts</b>	242
Jean-François Debord	
<b>Chapter 3. Duchenne today: Facial expression and facial surgery</b>	257
John T. Hueston	
<b>Chapter 4. Duchenne and facial expression of emotion</b>	270
Paul Ekman	
Index	285

## A. INTRODUCTION

# 1. A review of previous work on muscle action in facial expression

In this review I shall not confuse authors who were specifically concerned with facial expression in movement (the *symptomatology* of emotion) with those who have especially studied the signs of inclinations and habits, the study of the shape of the face at rest (properly called *physiognomy*).

The famous painter Lebrun is among the former,\* who represented the diverse aspects of facial expression produced by the emotions but without worrying about their laws of motion. There are others who have tried to analyze the expressive movements of the face by identifying the actions of the muscles of this region. I am only going to refer to the work of the latter authors in order to make known how my research differed from theirs; I will speak only of the principal figures among them.

### I. A historical survey

From earliest times anatomists recognized that the facial muscles govern the symptomatic expression of emotions; it was only toward the end of the last century and the beginning of this century that we have specifically studied the way each of these facial muscles contracts under the influence of emotion.

A. In 1792, the learned author of the *Dissertation on the Natural Variations that Characterize the Physiognomy of Men of Different Regions and Different Ages*, Camper,† who was also a talented painter, tried to determine the exact role of the facial muscles in the emotions; he studied the nature of the muscles to a lesser extent than the influence of the cranial nerves on facial expression.

\* Lebrun has articulated a method for learning how to draw the passions in a speech at the Royal Academy of Painting and Sculpture.

† P. Camper, *Discours sur les moyens de représenter d'une manière sûre les diverses passions qui se manifestent sur le visage*, 1792.

#### 4 *The mechanism of human facial expression*

He was not as happy in this type of research as in his other work. In fact, in attributing to the Vth cranial nerve a motor action similar to that of the VIIth, he placed the expressive movements of the face under the influence of either of these nerves. As he said:

In absolute sadness it is the Vth pair that act . . .

When a man is joyful, the only branches that act are those of the VIIth pair . . .

When we cry, the only difference is that all those muscles that are innervated by the Vth are even more strongly stimulated . . .

The VIIth makes us blush and blanch . . .

At the time when Camper was writing, the special properties of the VIIth and the Vth cranial nerves were unknown. Today we know the movements of the facial muscles are under the control of the VIIth, and that the Vth alone provides facial sensation; and that paralysis of the Vth does not disturb either the voluntary movement of the face, nor its expressive movements, whereas paralysis of the VIIth is necessarily followed by loss of facial mobility.

In Camper's discourse there is one single important proposition:

The folds of the face must necessarily cut at right angles the course of the muscle fibers.

He was the first author ever to make this remark, but he never proved it. I can prove that it is only applicable to certain facial muscles and that it is impossible to explain the formation of some folds or wrinkles during the play of facial expression based on this maxim.

B. Lavater devoted himself to the study of facial expression at rest, of *physiognomy* as such. His research was concerned with the difference between the combinations of contours and lines, the profiles and silhouettes that make up the static face. He certainly would not have neglected as much as he did of the study of facial expression in movement, which should serve as the basis for the examination of the physiognomy at rest, had he been either an anatomist or a physiologist or a doctor or even a naturalist.

The learned people who have undertaken the difficult task of collecting the different studies of this important observer, under the title of *Fragments*, understood that the study of facial expression in movement, entirely omitted by Lavater, should precede the study of physiognomy at rest.

In 1805, Moreau (de la Sarthe), Professor at the Faculty of Medicine at Paris University, and one of the principal collaborators in the great *Traité de la Physiognomie* of Lavater, composed an important article for this pub-



lication about *the structure, the use, and the characteristics of the different parts of the human face*.\*

Incontestably, he acquitted himself with talent. He addressed the particular and detailed examination of the action and effect of each muscle on facial expression. He touched on physiological questions, which according to this author (and this is also my opinion), had never been tackled in the best treatises of anatomy and physiology published before him.

C. An English physiologist who became renowned for his research on the nervous system, Charles Bell, published a book entitled *The Anatomy and Philosophy of Expression*. If he had published this book before the work of Moreau, the physiology of facial muscles would certainly owe progress to him.

His ideas on the exact action of the facial muscles and the manner in which they interact to express the emotions are very similar to those of the French anatomist. We suppose, however, that at that time he had no knowledge of the great work of Lavater – published the preceding year in Paris.

A book written by a man whose experimental investigations were some years later to throw such light on certain aspects of the nervous system could not be an ordinary work, despite the fact that it lacked innovation. His basic science linked with his practical knowledge of drawing and painting – especially his love of the fine arts – makes reading this elegantly produced book as instructive as it is pleasant.†

D. After the works I have just quoted, most of the authors who dealt with the same questions only reproduced the work of Moreau and Charles Bell. I must nevertheless mention a paper by Sarlandières.§ This writer seems to have studied the action of the facial muscles a little more closely than his predecessors, but the preceding historical facts show that he was wrong to write in his preface: "Not a single author (those who preceded him), has examined the way each muscle contracts in isolation, either under the influence of the emotions, or under the influence of the will, or independent of this will, to produce expression or gestures by these isolated or combined movements."

\* *L'art de connaître les hommes par la physionomie*, by Gaspard Lavater, 4th edition, 1820, vol. IV, art. 3.

† Charles Bell, who since his childhood was devoted to the art of drawing, had artistic talent. We find proof of this in his ink sketches, which he had reproduced by engraving in his treatises of great surgical operations (*Illustrations of the Operations of Surgery*, in-fol., 20 pl. colour, London, 1821).

§ *Physiologie de l'action musculaire appliquée aux arts d'imitation*.

Sarlandières attributed an influence on expression to the auricular muscles! It was certainly a new idea; unfortunately, the role he assigns them in this case is impossible.

I do not intend completely to analyze the works that I have mentioned; it will be more opportune to return to this subject when I deal with particular facts. It will then be easy for me to show that the authors of these works, some of whom have acquired great fame, have committed numerous errors; it could not be otherwise – as I shall explain.

## **II. Critical consideration of the various means of investigation used in myology**

Following a description of each muscle, the treatises in myology offer us more or less detailed study of their actions. Several methods have been employed to determine the action of the contractile elements; here they are according to Professor Bérard:

1. Sometimes the outline of the muscle during the production of certain movements displays the muscular action itself. The *m. biceps* and *m. brachialis* swell while the forearm flexes; obviously they are the flexors of this region. My temple bulges when my jaws come together; without a doubt *m. temporalis* above is pulling on the coronoid process of the mandible.
2. Sometimes the configuration of the articular surfaces indicates the use of the neighboring muscles. Never will a muscle passing over a ginglyform articulation determine the lateral movements; it will be a flexor or an extensor according to whether it approaches more to either side of the opposing planes in which the movements are made.
3. Furthermore, we refer to the excellent criteria that I shall describe, the true touchstone of muscular action.

Accepting the notion that a muscle shortens during its action, or rather that its fibers shorten (it's not exactly the same thing), we may dissect a muscle on a corpse, make different movements of the part and observe the movement when fibers stretch and the movement when they slacken. By this technique, you can determine almost certainly that in the living person the muscle at least contributes to bringing the limb into the position in which you see the fibers relaxed in the corpse. This simple method – so useful that I wouldn't know who invented it, nor even who taught it to me – must have been obvious to the first anatomist who saw a muscle shortening during its contraction.

4. Finally, when lively controversies arise about the actions of certain muscles, it is not rare to call up vivisectionists to arrive at a solution.

These techniques are perfectly applicable to the myology of the limbs and the trunk and I recognize, with Bérard, that thanks to them, we had advanced in the knowledge of the particular action of each muscle; but I don't think as he does, however, that there are only a few remaining sections to complete and a few opinions to rectify with regard to the myology of the limbs.\*

Without being unjust toward my predecessors, without sacrificing all past knowledge for the greater glory of modern progress, we may affirm today that before my electrophysiological research, we had very incomplete ideas of the actions of the muscles of the hand, and that it was impossible to explain even the simplest movements of the hand.

How, for example, in everyday use of the hand (as when one writes, and so forth), do we move the phalanges in opposite directions. It is of facts like this that we were ignorant – correct physiological theories being equally lacking for the muscles that move the foot and for those of other regions. The same will probably apply to those regions I have yet to explore.

If then, in spite of using the diverse methods of investigation common in myological studies, it was not possible to determine the individual action and the function of most of the muscles in the limbs, the difficulty is much greater in the face, where these techniques are not for the most part applicable.

First, in the face, we only recognize the action of a few of the muscles by their swelling or their outline; second, in this region there are no articular surfaces whose configuration can guide us to the action of the neighboring muscles; third, this veritable touchstone of myology, of *approximating the two extremities of a muscle to relax it*, is not applicable to the myology of the face. What use can such experimental methods be to studying the true actions of the muscles of the face, the wrinkles, the folds, the outlines numerous and infinitely varied that can all be imprinted on the skin? They could not, in fact, show the influence that these muscles exert on expression.

One really has to admire the observational talent of those who have been able to guess, so to speak, the expressive action of certain muscles

\*When Bérard wrote these lines, my electrophysiological research on the hand, the shoulder, the foot, and the diaphragm were not yet published. He later recognized that his muscle physiology left a lot to be desired.

of the face in spite of being deprived of all means of experimentation and control. Nevertheless, the opinions they have expressed in this regard were nothing but assertions that needed to be studied by direct experimentation.

One must also understand that these observers committed many more errors than they realized because of the optical illusions produced by movements limited to certain points of the face. I will shortly demonstrate, for example, that seeing a slight movement of muscles of the eyebrow one experiences a mirage that gives the impression of a general contraction of the face.

*Live dissections*, if practicable on man, would not resolve the problems in question, for it would be necessary to sacrifice the skin on which the signs of the expressive language of facial expression are drawn.

Let us examine the value of the system recommended by Camper. According to this celebrated observer, the folds and wrinkles of the face are necessarily perpendicular to the direction of action of the muscles. Does it follow then that in all expressive movements we can recognize the muscles that are acting by the direction of the wrinkles? Is the muscle that crosses the direction of a wrinkle produced by an expressive movement necessarily in contraction?

This seems to be the opinion of Camper. It has also been the method employed after him by other workers to explore the motor agents involved in particular expressions. Ah well! Nothing is less certain, or rather, nothing is more deceptive than this method!

To prove it, I shall make a comparison. If one exerts a vertical or oblique traction above and below a point on a curtain, one sees, depending on the suppleness and age of the material, folds form in various directions and sometimes at different points of this surface.

Similarly, with a simple traction on the skin of the face, one sees wrinkles and furrows form in diverse directions and in places more or less removed from one another. Moreover, the skin surface is not uniform; in the relaxed state it displays the furrows and reliefs due to the tonic predominance of such and such a muscle of this region, a predominance that is infinitely variable, depending on the age of the subject and the habitual play of emotions. This is what constitutes the individual facial expression.

So! All traction limited to a point on the face changes these furrows and outlines, either exaggerating or effacing them, or altering their direction.

An example to develop my ideas further. Supposing a force acts from the corner of the lips to the external side of the cheekbone (as with *m*.

*zygomaticus major*), then the nasolabial fold creases, curving in a diverging manner, and the wrinkles seem to radiate, in most cases, from the external angle of the eye.

Here is how we must explain these movements, according to Camper's theory that the folds and wrinkles of the face are necessarily perpendicular to the direction of the responsible muscles. The corner of the mouth has been moved by *m. zygomaticus major*; the nasolabial fold is creased by the action of *m. levator labii superioris alaeque nasi*; the wrinkles radiating from the external angle of the eye are due to the action of *m. orbicularis oculi*. I shall demonstrate that this explanation is completely erroneous and that *m. zygomaticus major* alone produces all the wrinkles and all the furrows.

What I have said of *m. zygomaticus major* is applicable to most of the expressive muscles of the face.

### III. The background to my electrophysiological research on facial expression in movement

All movements, both voluntary and instinctive, result from simultaneous (synergistic) contraction of a more or less large number of muscles. Nature has not given man the ability to localize the action of the nervous fluid to an individual muscle to provoke an isolated contraction. This ability, functionally useless, would have exposed man to accidents and deformities, as I have already demonstrated elsewhere.\*

As we cannot break down the movements and thus analyze the individual actions of muscles, how may we study them? How are we to arrive at a precise knowledge of the true action of these muscles?

If we were able to master the electrical current, an agent so analogous to the nervous fluid, and could limit its effect to individual muscles, we could certainly shed some light on their localized actions. In the face in particular, one could determine the isolated actions of the muscles with ease! Armed with electrodes, one would be able, like nature herself, to paint the expressive lines of the emotions of the soul on the face of man. What a source of new observations!

For a dozen years, this has been the fundamental idea of my electrophysiological research, an idea with a rich future that inflamed my imagination.

This is not the place to report the long series of physical and anatomical experiments through which I had to pass, and the difficulties I have

\* *De l'électrisation localisée et de son application à la physiologie, à la pathologie et à la thérapeutique.* Paris, 1855; 2nd edition, 1861.

had to surmount before proving my idea. After several years of experimentation, I can apply electrical power to the surface of the body, in a controlled manner, and then make it traverse the skin without burning or cutting it and concentrate its action in one muscle or in a muscle bundle, in a nerve trunk or in a nerve branch.

The first application of the method of electrization that I invented was in the study of the face. "Localized electrization" has helped me resolve the problem, both so difficult and so interesting, stated in the previous paragraph; it permitted me to see the tiny radiations of the muscles occurring under the influence of the instrument. The muscular contraction revealed their direction and their anatomical situation more clearly than the scalpel of the anatomist. At least this is true in the face, where one inevitably sacrifices, in anatomical dissections, the terminal portions of the muscle fibers that have their crucial insertion into the skin.

This is then a new sort of anatomy, to which one can apply the two words by which Haller described physiology: it is *animated anatomy* – *anatome animata*; Soemmerring would have without doubt called it *contemplatio musculi vivi*.

By 1850, I had enough new facts for me to present a series of papers entitled "Functions of the muscles of the face demonstrated by localized electrization" to the Academies of Science and of Medicine of Paris, based on my electrophysiological experiments. This work provoked the brilliant discussion of Professor Bérard, member of the Academy of Medicine, in 1851.\* I take the liberty of affirming that this electromuscular method had not been used before my experiments.

No one thought that the study of myology could benefit from gross experiments by a physician who provoked convulsions on the faces of his tortured subjects using electrical currents.

It has been suggested that C. Bell and Sarlandières tried to study the muscles of the face using galvanization. These authors don't mention this in their writings; furthermore, if they had used this method of exploration, they would certainly not have committed the errors I have had to rectify.

It will be recognized, I hope, that the honor of revealing the mechanism of human facial expression, this anatomical analysis of the emotions, was reserved for the method of electrization, which alone permitted the exact determination of the isolated action of the muscles and the dissection of their movements.

My initial research was not and could not be anything but a rough

\*Meeting of 18 March 1851, *Bulletin de l'Académie de médecine*, t. XVI, p. 609.

sketch. The electrophysiological facts I originally observed did not give me a complete idea of the physiological movements of the face. And which actions should one give to each of the muscles of the face to see how they act in the play of facial expression? I was far from answering these complex and difficult questions, whose surface I had barely scratched.

Today, based on long and continuing experimentation, I believe that I can reveal my research to the public. I hope it will shed great light on these questions.